105th Congress, 1st Session – – – – – – – – – – – – – House Document 105–153

NEW JERSEY SHORE PROTECTION STUDY

COMMUNICATION

FROM

THE ACTING ASSISTANT SECRETARY (CIVIL WORKS), THE DEPARTMENT OF THE ARMY

TRANSMITTING

A REPORT ON A STORM DAMAGE REDUCTION AND SHORELINE PROTECTION PROJECT FOR BRIGANTINE INLET TO GREAT EGG HARBOR INLET, ABSECON ISLAND, NEW JERSEY, PURSUANT TO PUB. L. 104–303, SEC. 101(b)(13)

OCTOBER 21, 1997.—Referred to the Committee on Transportation and Infrastructure and ordered to be printed

U.S. GOVERNMENT PRINTING OFFICE
44–465 WASHINGTON : 1997

105th Congress, 1st Session – – – – – – – – – – – – House Document 105–153

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DEPARTMENT OF THE ARMY
OFFICE OF THE ASSISTANT SECRETARY
CIVIL WORKS
108 ARMY PENTAGON
WASHINGTON DC 20310-0108

16 OCT 1997

REPLY TO
ATTENTION OF

Honorable Newt Gingrich
Speaker of the House
  of Representatives
Washington, D.C. 20515

Dear Mr. Speaker:

Section 101(b)(13) of the Water Resources Development Act (WRDA) of 1996, authorized a storm damage reduction and shoreline protection project for Brigantine Inlet to Great Egg Harbor Inlet, Absecon Island, New Jersey. However, since the project is a beach nourishment project located in a recreation and tourist area, and involves a long-term, 50-year Federal investment beyond initial construction, the project would receive a low budget priority. Therefore, in view of the current constrained budget situation, it is not likely that funding for this project will be included in future budget requests.

The project is described in the report of the Chief of Engineers dated December 23, 1996, which includes other pertinent reports and comments. These reports are submitted in partial response to a resolution adopted by the House Committee on Public Works and Transportation on December 10, 1987, and a resolution adopted by the Senate Committee on Environment and Public Works on December 17, 1987. The views of the State of New Jersey, the Departments of the Interior and Transportation, and the Environmental Protection Agency are set forth in the enclosed report.

The authorized project extends along the entire oceanfront of Absecon Island and portions of Atlantic City's Brigantine Inlet beachfront. The total length of the project is about 8.4 miles. The plan consists of a 200-foot-wide beach berm at an elevation of +8.5 feet National Geodetic Vertical Datum (NGVD) and a storm dune with a crest width of 25 feet at an elevation of +16 feet NGVD along the beachfront of Atlantic City; a 100-foot-wide beach berm at an elevation of +8.5 feet NGVD and a storm dune with a crest width of 25 feet at an elevation of +14 feet NGVD along the beachfront of Ventnor, Margate, and Longport; and two sections of timber bulkhead at a top elevation of +14 feet NGVD, and stone revetment, along the Brigantine Inlet beachfront of Atlantic City. The plan also includes dune grass planting, sand dune fencing, vehicle access ramps, and dune walkovers. Additionally, the project includes advance beach fill and periodic renourishment to ensure the integrity of the design. The plan requires the placement of about 6.2 million cubic yards of initial beach fill to be obtained from nearby offshore borrow sites, and subsequent future periodic nourishment of about 1.7 million cubic yards every three years for 50 years. The project has been designed in a manner that minimizes significant adverse environmental impacts. No separable fish and wildlife mitigation is required.

Based on October 1995 price levels, the total first cost of the project is estimated at about $52,000,000, with a Federal first cost of about $34,000,000, and a non-Federal first cost of about $18,000,000. In accordance with WRDA 1986, cost sharing is based on shoreline ownership, extent and type of shoreline development, and extent of public benefits and public access in the project area. The total cost of future periodic nourishment and project monitoring is estimated at about $213,310,000, which would be spent over a 50-year period.

The Office of Management and Budget advises that there is no objection to the submission of this report to the Congress for information. A copy of its letter is enclosed in the report.

Sincerely,

John Zirschky

John H. Zirschky
Acting Assistant Secretary of the Army
(Civil Works)

Enclosure

COMMENTS OF THE OFFICE OF MANAGEMENT AND BUDGET

EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF MANAGEMENT AND BUDGET
WASHINGTON, D.C. 20503

AUG 1 1997

Honorable John H. Zirschky
Acting Assistant Secretary of the
Army for Civil Works
Pentagon - Room 2E570
Washington, D.C. 20310-0108

Dear Dr. Zirschky:

As required by Executive Order 12322, the Office of Management and Budget has completed its review of former Assistant Secretary Lancaster's recommendation for the New Jersey Shore Protection Study, Brigantine Inlet to Great Egg Harbor, Absecon Island.

The recommendation for this project in his letter of April 8, 1997, is consistent with the policies and program of the President. The Office of Management and Budget does not object to submission of this report to Congress.

Sincerely,

Kathleen Peroff
Deputy Associate Director
Energy and Science Division

X

COMMENTS OF THE STATE OF NEW JERSEY

State of New Jersey
Department of Environmental Protection
Natural and Historic Resources
Division of Engineering and Construction

Christine Todd Whitman
Governor

Robert C. Shinn, Jr.
Commissioner

March 3, 1997

Lt. Colonel Robert B. Keyser
Phila. Dist. Corps of Engineers
Wanamaker Bldg.
100 Penn Square East
Philadelphia, PA 19107-3390

Dear Lt. Col. Keyser:

I am writing in support of the project identified by the Corps of Engineers' Final Interim Feasibility Report and Final Environmental Impact Statement for Absecon, New Jersey, dated August 1996. We are aware that a Corps of Engineers Chief's Report was completed in December 1996 which resulted in this project being authorized by Section 101(b) of the Water Resources Development Act of 1996. We fully support this project being considered for future construction and the State is prepared to enter into a Project Cooperation Agreement (PCA). We are aware of the cost sharing requirements of the PE&D phase and are willing to cost share this portion of the project at 75% Federal and 25% non-Federal, understanding that adjustments may be necessary to bring the non-Federal PE&D cost sharing in line with the project cost sharing during the first year of construction.

We are also aware that some issues still remain regarding final CZM certification of this project. As previously agreed between respective agencies, these issues will be resolved during the PE&D phase of this project.

The State of New Jersey is very supportive of this shore protection project. We look forward to working with the Corps of Engineers in constructing this important project.

Sincerely,

Bernard Moore
Bernard J. Moore
Administrator

COMMENTS OF THE DEPARTMENT OF THE INTERIOR

United States Department of the Interior

OFFICE OF THE SECRETARY
Washington. D.C. 20240

ER-96/0630

NOV 22 1996

Mr. Raleigh H. Leef
Acting Chief, Policy Division
Directorate of Civil Works
ATTN: CECW-AR (SA)
7701 Telegraph Road
Alexandria, VA 22315-3861

Dear Mr. Leef:

The Department of the Interior (Department) has reviewed the Chief of Engineers Proposed Report and the Final Feasibility Report/Environmental Impact Statement (FEIS) for the New Jersey Shore Protection Study, Brigantine Inlet to Great Egg Harbor Inlet, Absecon Island Interim Feasibility Study. The subject documents address shore protection for the communities of Atlantic City, Ventnor, Margate, and Longport, in Atlantic County, New Jersey.

Background

The Department provided 13 recommendations in correspondence from the Department to the Corps dated July 16, 1996 (copy enclosed). These concerns are identified below.

1. Consult with the New Jersey Bureau of Shellfisheries to minimize impacts on surf clams at Borrow area "A."

2. Avoid creating excessively deep, poorly flushed borrow areas.

3. Use a hydraulic-pipeline dredging method and schedule dredging during the period of lowest biological activity (November to January) to minimize impacts on benthic organisms.

4. Conduct each renourishment dredging phase in a limited area of Borrow area "A" and alternate locations for each subsequent renourishment cycle (rotational dredging).

5. Provide the federal resource agencies (e.g., U.S. Fish and Wildlife Service (FWS) and National Marine Fisheries Service) with copies of borrow area update surveys, the benthic monitoring program, and results of the benthic monitoring program.

6. Obtain a perpetual deed restriction or conservation easement for the newly created beach and adjacent beach areas.

7. Relocate the boardwalk landward between Atlantic Avenue and Oriental Avenue and construct a bulkhead and revetment on the seaward side of the boardwalk, in order to minimize impacts on shallow water habitat.

8 Coordinate with the FWS prior to initial beach nourishment to ensure that piping plovers do not occur on the project area beaches.

9. Establish protective zones, if piping plovers use these beaches after initial beach nourishment, in accordance with the FWS's "Guidelines for Managing Recreational Activities in Piping Plover Breeding Habitat on the U.S. Atlantic Coast to Avoid Take Under Section 9 of the Endangered Species Act." The Corps would be responsible for providing materials (e.g., fencing, signs) or funds for materials for establishing such protective zones.

10. Consult with the FWS pursuant to Section 7 of the Endangered Species Act for each renourishment phase of the project for the project life (i.e., 50 years) on beaches where piping plovers are documented.

11. Notify each municipality on Absecon Island about the restrictions that will be placed on recreational activities and beach management (e.g., beach raking) if piping plovers occur on the beaches of Absecon Island. In addition, the Corps should provide each municipality with a copy of the above-mentioned Guidelines.

12. In the event that beach nesting birds do nest on Absecon Island, develop effective educational materials or provide funds for public education and outreach to inform the public about beach nesting birds and promote public support for these species.

13. Develop and implement a shorebird monitoring program in cooperation with the FWS that monitors the use of the proposed nourished beaches for shorebirds, in particular piping plovers. Additionally, submit the proposed shorebird monitoring program to the FWS for review and comment.

Additional Concern

In order to further minimize adverse impacts on finfish and shellfish from dredging and beach nourishment, the Department recommends that the proposed 200-foot-wide berm adjacent to Atlantic City be reduced to 100 feet wide. A 100-foot-wide berm is consistent with the width of constructed beaches in neighboring municipalities (i.e., Ventnor, Margate, and Longport) and with the width of other municipal beaches in Monmouth and Cape May counties. Therefore, minimizing the width of the berm would not only reduce potential adverse impacts on finfish and shellfish resources, but would also provide the same shoreline protection afforded other communities.

<u>Departmental Position</u>

The Department is satisfied that the Corps has adequately addressed recommendations 2, 4, 5, 6, 8, 10, and 11 in the FEIS. However, the Corps has not adequately addressed recommendations 1, 3, 7, 9, 12, and 13 regarding: impacts on shellfish; dredging procedures; boardwalk relocation; potential use of renourished areas by piping plovers; public education regarding beach nesting birds; and shorebird monitoring, respectively. Therefore, the Department continues to recommend that the Corps incorporate recommendations 1, 3, 7, 9, 12, and 13 into the final project design to minimize project-related adverse impacts to fish and wildlife resources. In addition, the Department recommends that the Corps reduce the proposed berm for Atlantic City from 200 feet to 100 feet wide, in order to minimize impacts on finfish and shellfish resources. A 100-foot- wide berm would reduce the amount of dredge material needed for beachfill while still providing the same shoreline protection afforded other New Jersey shore communities. The Department encourages the Corps to resolve the above-mentioned concerns and incorporate Departmental recommendations in the final project design during the next phase of project development. The Department and the FWS will continue to cooperate fully to resolve these aforementioned concerns.

If you have any questions regarding these comments or require further assistance on issues regarding fish and wildlife resources in New Jersey, including federally listed threatened or endangered species, please contact the FWS at the following address:

Supervisor
U.S. Fish and Wildlife Service
New Jersey Field Office
Ecological Services
927 N. Main Street, Building D
Pleasantville, New Jersey 08232
(609) 646-9310

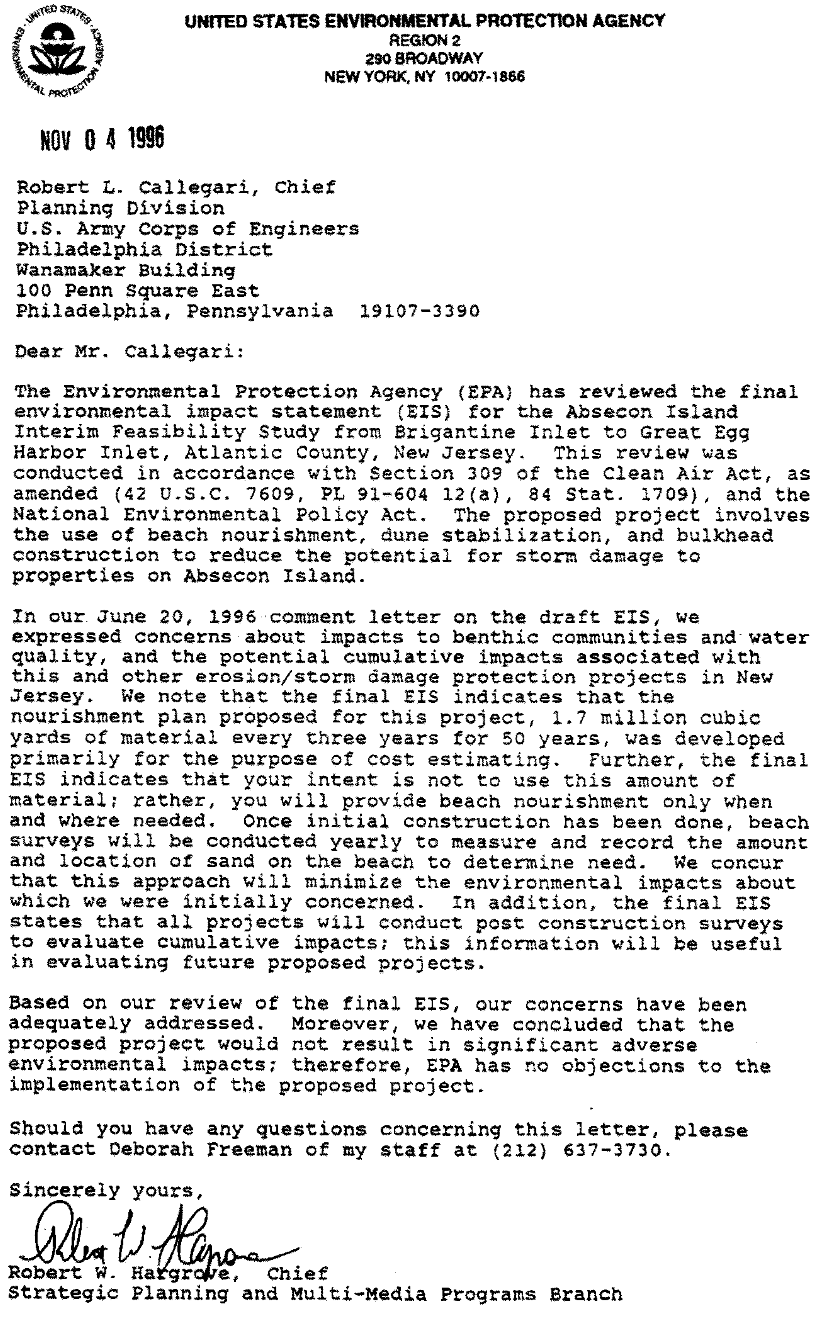
Thank you for the opportunity to provide these comments.

Sincerely,

Kenneth [illegible]

for Willie R. Taylor, Director
Office of Environmental
Policy and Compliance

COMMENTS OF THE ENVIRONMENTAL PROTECTION AGENCY



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 2
290 BROADWAY
NEW YORK, NY 10007-1866

NOV 0 4 1996

Robert L. Callegari, Chief
Planning Division
U.S. Army Corps of Engineers
Philadelphia District
Wanamaker Building
100 Penn Square East
Philadelphia, Pennsylvania 19107-3390

Dear Mr. Callegari:

The Environmental Protection Agency (EPA) has reviewed the final environmental impact statement (EIS) for the Absecon Island Interim Feasibility Study from Brigantine Inlet to Great Egg Harbor Inlet, Atlantic County, New Jersey. This review was conducted in accordance with Section 309 of the Clean Air Act, as amended (42 U.S.C. 7609, PL 91-604 12(a), 84 Stat. 1709), and the National Environmental Policy Act. The proposed project involves the use of beach nourishment, dune stabilization, and bulkhead construction to reduce the potential for storm damage to properties on Absecon Island.

In our June 20, 1996 comment letter on the draft EIS, we expressed concerns about impacts to benthic communities and water quality, and the potential cumulative impacts associated with this and other erosion/storm damage protection projects in New Jersey. We note that the final EIS indicates that the nourishment plan proposed for this project, 1.7 million cubic yards of material every three years for 50 years, was developed primarily for the purpose of cost estimating. Further, the final EIS indicates that your intent is not to use this amount of material; rather, you will provide beach nourishment only when and where needed. Once initial construction has been done, beach surveys will be conducted yearly to measure and record the amount and location of sand on the beach to determine need. We concur that this approach will minimize the environmental impacts about which we were initially concerned. In addition, the final EIS states that all projects will conduct post construction surveys to evaluate cumulative impacts; this information will be useful in evaluating future proposed projects.

Based on our review of the final EIS, our concerns have been adequately addressed. Moreover, we have concluded that the proposed project would not result in significant adverse environmental impacts; therefore, EPA has no objections to the implementation of the proposed project.

Should you have any questions concerning this letter, please contact Deborah Freeman of my staff at (212) 637-3730.

Sincerely yours,

Robert W. Hargrove, Chief
Strategic Planning and Multi-Media Programs Branch

COMMENTS OF THE DEPARTMENT OF TRANSPORTATION

U.S. Department
of Transportation
**United States
Coast Guard**

Commandant
United States Coast Guard

2100 Second Street, S.W.
Washington, DC 20593-0001
Staff Symbol: G-MOR
Phone: (202) 267-0518
FAX: (202) 267-4085

16450
November 25, 1996

Policy Division, Policy Review Branch
Department of the Army
U.S. Army Corps of Engineers
Washington, DC 20314-1000

Dear Sir:

Recently you sent copies of the proposed report for the Chief of Engineers and report of the district engineer on the listed projects. In addition, you sent a letter dated October 25, 1996 requesting an expedited review of these documents. We have reviewed the proposed reports and have no comments to offer.

Chesapeake and Delaware Canal, Baltimore Harbor Connecting Channels (Deepening), Delaware and Maryland, sent September 12, 1996, 90 Days ending December 11, 1996.

Saint Paul, Alaska, sent September 17, 1996, 90 days ending December 16, 1996.

New Jersey Shore Protection Study, Brigantine Inlet to Great Egg Harbor Inlet, Absecon Island Interim, sent September 19, 1996, 90 days ending December 18, 1996.

Kaweah River Basin, California, sent September 25, 1996, 90 days ending December 24, 1996.

Thank you for providing the Coast Guard the opportunity to review the proposed reports. We look forward to receiving the final reports when issued.

Sincerely,

R. E. BENNIS
Captain, U.S. Coast Guard
Chief, Office of Response
By direction

NEW JERSEY SHORE PROTECTION STUDY

REPORT OF THE CHIEF OF ENGINEERS, DEPARTMENT OF THE ARMY

DEPARTMENT OF THE ARMY
OFFICE OF THE CHIEF OF ENGINEERS
WASHINGTON, D.C. 20314-1000

REPLY TO
ATTENTION OF:

CECW-PE (10-1-7a) 23 DEC 1996

SUBJECT: New Jersey Shore Protection Study, Brigantine Inlet to Great Egg Harbor Inlet, Absecon Island Interim

THE SECRETARY OF THE ARMY

1. I submit for transmission to Congress my report on the study of hurricane and storm damage reduction for Absecon Island, New Jersey, on the Atlantic coast of New Jersey, located in Atlantic County. It is accompanied by the report of the district and division engineers. These reports are in partial response to a resolution by the Committee on Environment and Public Works of the United States Senate dated 17 December 1987. This resolution requested review of existing reports of the Chief of Engineers for the entire coast of New Jersey with a view to study, in cooperation with the State of New Jersey, its political subdivisions and agencies and instruments thereof, the changing coastal processes along the coast of New Jersey. This report is on the Absecon Island Interim of the Brigantine Inlet to Great Egg Harbor Inlet reach of the New Jersey Shore Protection Study.

2. Section 101(b)(13) of the Water Resources Development Act of 1996, Public Law 104-303, authorized construction of the Absecon Island, New Jersey, project for storm damage reduction and shoreline protection subject to completion of a final report of the Chief of Engineers on or before 31 December 1996 and subject to the conditions recommended in that final report. This report constitutes the final report of the Chief of Engineers required by WRDA 1996. The authorizing language for the Absecon Island project reflects a total cost of $52,000,000, with an estimated Federal cost of $34,000,000 and an estimated non-Federal cost of $18,000,000.

3. The plan developed by the district engineer generally extends the entire oceanfront length of Absecon Island and portions of Atlantic City's inlet frontage, for a total length of 44,425 feet. The plan consists of a 200-foot-wide beach berm at an elevation +8.5 feet National Geodetic Vertical Datum (NGVD) and a dune at elevation +16 feet NGVD. The dune would have a crest width of 25 feet along the Atlantic City shorefront, transitioning into a 100-foot-wide beach berm at an elevation of +8.5 feet NGVD and a dune at elevation +14 feet NGVD. The dune crest width would be 25 feet along the shorefront of the communities of Ventnor, Margate, and Longport. In addition, two sections of timber bulkhead with stone revetment from Oriental Avenue to Atlantic Avenue, totaling 1,050 linear feet, and from Madison Avenue to Melrose Avenue, totaling 550 linear feet, would be constructed along the Brigantine Inlet frontage. Both bulkheads will have a top elevation of +14 feet NGVD. The plan also includes appurtenant project features such as

dune grass planting, sand dune fencing, vehicle access ramps, and dune walkovers. Additionally, advance beach fill and periodic nourishment would be needed to ensure the integrity of the design. Actions are included in project design and construction to offset environmental impacts. No environmental mitigation features are proposed.

4. As reported by the district engineer, based on October 1995 price levels, the total first cost of the plan is estimated at $52,146,000. Under cost sharing specified by the Water Resources Development Act of 1986, Public Law 99-662, $33,313,000 of the total first cost of the plan would be Federal, and $18,833,000 would be non-Federal. Of the non-Federal share, the total cash contribution required would be $17,938,000. The balance of the non-Federal share would consist of $895,000 for the estimated creditable cost for lands, easements, rights-of-way, relocations, and suitable borrow and dredged or excavated material disposal areas. The plan requires renourishment of the beachfill every 3 years or 16 times during the 50-year period following the initial construction. At October 1995 prices, periodic renourishment costs are estimated at $12,188,000, for each occurrence. Total periodic renourishment costs are estimated at $195,002,000, stated in terms of October 1995 prices. Based on a discount rate of 7.625 percent and a 50-year period of economic analysis, average annual periodic renourishment costs are estimated at $2,434,000 Federal and $1,310,000 non-Federal. Costs associated with periodic monitoring activities, currently estimated at $6,370,000 over the 50-year economic life of the project, as identified in the operations and maintenance manual developed by the district engineer, will be borne by the non-Federal sponsor. The cumulative Federal share of continuing construction costs (50 years) would be $134,511,000. The cumulative non-Federal share of periodic renourishment and project monitoring costs (50 years) would be $78,799,000. The ultimate project costs would be $265,456,000, shared $167,824,000 Federal and $97,632,000 non-Federal. Based on a discount rate of 7.625 percent and a 50-year period of economic analysis, average annual benefits are estimated at $16,356,000, and average annual costs are estimated at $8,486,000. The resulting ratio of benefits-to-costs is 1.9. The plan developed by the district engineer is the national economic development plan.

5. I generally concur in the findings of the reporting officers, except for cost-sharing of project monitoring costs. The reporting officers treated all periodic monitoring costs as project costs. As reflected in paragraph 4 above, cost associated with periodic monitoring activities, as identified in the operations and maintenance manual developed by the district engineer, will be borne by the non-Federal sponsor. The plan developed is technically sound, economically justified, and socially and environmentally acceptable. The plan conforms with essential elements of the U.S. Water Resources Council's Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies and complies with other Administration and legislative policies

and guidelines on project development. However, based on current budget priorities, projects like Absecon Island, New Jersey, would receive a low budget priority, and it is unlikely that funding for this project will be included in future budget requests.

6. However, in light of the authorization provided by Section 101(b)(13) of WRDA 1996, should the project receive construction appropriations for Federal implementation, it would be implemented subject to the cost-sharing and other applicable requirements for hurricane and storm damage reduction projects as established by WRDA 1986, as amended, and would be implemented with such modifications as the Chief of Engineers deems advisable within his discretionary authority. Federal implementation is also subject to the non-Federal sponsor agreeing to comply with applicable Federal laws and policies being responsible for the following items of local cooperation:

a. Provide 35 percent of total project costs assigned to hurricane and storm damage reduction and as further specified below:

(1) Provide all lands, easements, and rights-of-way, including suitable borrow and dredged or excavated material disposal areas, and perform or ensure the performance of all relocations determined by the Federal Government to be necessary for the initial construction, periodic nourishment, operation, and maintenance of the project.

(2) Provide all improvements required on lands, easements, and rights-of-way to enable the proper disposal of dredged or excavated material associated with the initial construction, periodic nourishment, operation, and maintenance of the project. Such improvements may include, but are not necessarily limited to, retaining dikes, wasteweirs, bulkheads, embankments, monitoring features, stilling basins, and dewatering pumps and pipes.

(3) Provide, during construction, any additional amounts as are necessary to make its total contribution equal to 35 percent of total project costs assigned to hurricane and storm damage reduction.

b. For so long as the project remains authorized, operate, maintain, repair, replace, and rehabilitate the completed project, or functional portion of the project, at no cost to the Federal Government, in a manner compatible with the project's authorized purpose and in accordance with applicable Federal and State laws and regulations and any specific directions prescribed by the Federal Government.

c. Give the Federal Government a right to enter, at reasonable times and in a reasonable manner, upon property that the non-Federal sponsor, now or hereafter, owns or controls for access to the project for the purpose of inspection, and, if necessary, after failure to perform by the non-Federal sponsor, for the purpose of completing, operating, maintaining, repairing, replacing, or rehabilitating the project. No completion, operation, maintenance, repair, replacement, or rehabilitation by the Federal Government shall relieve the non-Federal sponsor of responsibility to meet the non-Federal sponsor's obligations, or to preclude the Federal Government from pursuing any other remedy at law or equity to ensure faithful performance.

d. Hold and save the United States free from all damages arising from the initial construction, periodic nourishment, operation, maintenance, repair, replacement, and rehabilitation of the project and any project-related betterments, except for damages due to the fault or negligence of the United States or its contractors.

e. Keep and maintain books, records, documents, and other evidence pertaining to costs and expenses incurred pursuant to the project in accordance with the standards for financial management systems set forth in the Uniform Administrative Requirements for Grants and Cooperative Agreements to State and Local Governments at 32 Code of Federal Regulations (CFR) Section 33.20.

f. Perform, or cause to be performed, any investigations for hazardous substances that are determined necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Public Law 96-510, as amended, 42 U.S.C. 9601-9675, that may exist in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be required for the initial construction, periodic nourishment, operation, and maintenance of the project. However, for lands that the Federal Government determines to be subject to the navigation servitude, only the Federal Government shall perform such investigations unless the Federal Government provides the non-Federal sponsor with prior specific written direction, in which case the non-Federal sponsor shall perform such investigations in accordance with such written direction.

g. Assume complete financial responsibility, as between the Federal Government and the non-Federal sponsor for all necessary cleanup and response costs of any CERCLA regulated materials located in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be necessary for the initial construction, periodic nourishment, operation, or maintenance of the project.

h. As between the Federal Government and the non-Federal sponsor, the non-Federal sponsor shall be considered the operator of the project for the purpose of CERCLA liability. To the maximum extent practicable, operate, maintain, repair, replace, and rehabilitate the project in a manner that will not cause liability to arise under CERCLA.

i. Comply with the applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public Law 91-646, as amended by Title IV of the Surface Transportation and Uniform Relocation Assistance Act of 1987 (Public Law 100-17), and the Uniform Regulations contained in 49 CFR Part 24, in acquiring lands, easements, and rights-of-way, required for the initial construction, periodic nourishment, operation, and maintenance of the project, including those necessary for relocations, borrow materials, and dredged or excavated material disposal, and inform all affected persons of applicable benefits, policies, and procedures in connection with said Act.

j. Comply with all applicable Federal and State laws and regulations, including, but not limited to, Section 601 of the Civil Rights Act of 1964, Public Law 88-352 (42 U.S.C. 2000d), and Department of Defense Directive 5500.11 issued pursuant thereto, as well as Army Regulation 600-7, entitled "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army."

k. Provide 35 percent of that portion of total historic preservation mitigation and data recovery costs attributable to hurricane and storm damage reduction that are in excess of 1 percent of the total amount authorized to be appropriated for hurricane and storm damage reduction.

l. Participate in and comply with applicable Federal floodplain management and flood insurance programs in accordance with Section 402 of Public Law 99-662, as amended.

m. Within one year after the date of signing a project cooperation agreement, prepare a floodplain management plan designed to reduce the impact of future flood events in the project area. The plan shall be prepared in accordance with guidelines developed by the Federal Government and must be implemented not later than one year after completion of construction of the project.

n. Prescribe and enforce regulations to prevent obstruction of or encroachment on the project that would reduce the level of protection it affords or that would hinder operation and maintenance of the project.

o. Not less than once each year, inform affected interests of the extent of protection afforded by the project.

p. Publicize floodplain information in the area concerned and provide this information to zoning and other regulatory agencies for their use in preventing unwise future development in the floodplain, and in adopting such regulations as may be necessary to prevent unwise future development and to ensure compatibility with protection levels provided by the project.

q. For so long as the project remains authorized, the non-Federal sponsor shall ensure continued conditions of public ownership and use of the shore upon which the amount of Federal participation is based.

r. Provide and maintain necessary access roads, parking areas, and other public use facilities, open and available to all on equal terms.

JOE N. BALLARD
Lieutenant General, USA
Chief of Engineers

REPORT OF THE DISTRICT ENGINEER

BRIGANTINE INLET TO GREAT EGG HARBOR INLET FEASIBILITY STUDY

Absecon Island Interim Study

Final Feasibility Report
August 1996

SYLLABUS

This report presents the results of a feasibility phase study to determine an implementable solution and the extent of Federal participation in a storm damage reduction project for the communities of Atlantic City, Ventnor, Margate and Longport, New Jersey. This feasibility study is prepared based on the recommendations of the reconnaissance study completed in 1992, which identified possible solutions to the storm damage problems facing the study area. The reconnaissance study also determined that such a solution was in the Federal interest and identified the non-Federal sponsor.

The feasibility study was cost shared between the Federal Government and State of New Jersey through the New Jersey Department of Environmental Protection (NJDEP), and was conducted under the provisions of the Feasibility Cost Sharing Agreement executed 20 January 1993. The feasibility study was initiated in March 1993.

The Absecon Island study area stretches for approximately 9.2 miles along Atlantic City's Absecon Inlet frontage and the ocean coast of Absecon Island. The area has been subject to major flooding, erosion and wave attack during storms, causing damage to structures, and, since 1992, was twice declared a National Disaster Area by the President of the United States. In recent years, continued erosion has resulted in a reduction of the height and width of the beachfront, which has increased the potential for storm damage.

The feasibility study evaluated various alternative plans of improvement formulated on hurricane and storm damage reduction. The NED plan has been identified as a 200 foot wide berm at elevation + 8.5 ft NGVD with a dune at elevation + 16 ft NGVD with a crest width of 25 feet for the oceanfront of Atlantic City, a 100-foot wide berm at elevation + 8.5 ft NGVD with a dune at elevation + 14 ft NGVD with a crest width of 25 feet for the oceanfront of Ventnor, Margate & Longport, and two timber bulkhead sections with top elevation of +14 NGVD and revetment along the inlet frontage of Atlantic City. The selected oceanfront plans include dune grass, dune fencing and suitable advance beachfill and periodic nourishment to ensure the integrity of the design. The plan requires 6,174,013 cubic yards of initial fill to be placed from designated offshore borrow sites, and subsequent periodic nourishment of 1,666,000 cubic yards every 3 years for 50 years.

The feasibility report is based on October 1995 price levels and the Federal interest rate of 7.625%. The economic analysis for the selected plan indicates that the proposed plan will provide annual benefits of $16,356,000 which when compared to annual cost of the proposed plan of $8,486,000, yields a benefit to cost ratio of 1.9 with $7,870,000 in net excess benefits.

The total initial project cost of construction is currently estimated to be $52,146,000 (at October 1995 price levels). The Federal share of this first cost is $33,896,000, and the non-Federal share $18,251,000. Periodic nourishment is estimated at $12,188,000 on a three year cycle and will be similarly cost shared 65-35 for the life of the project. The ultimate project cost which includes initial construction, fifty years of periodic nourishment and monitoring is currently estimated to be $265,456,000 (at October 1995 price levels).

The proposed plan is technically sound, economically justified, and socially and environmentally acceptable; however, the current Administration's budgetary policy precludes further Federal participation in the design and construction of hurricane and storm damage reduction projects. This means that the feasibility phase of study will be completed, however, Federal funds will not be budgeted future construction of this project.

DESCRIPTION OF THE SELECTED PLAN FOR ABSECON ISLAND

Project Title: New Jersey Shore Protection Study, Brigantine Inlet to Great Egg Harbor Inlet Feasibility Study, Absecon Island Interim Report

Description: The proposed project provides a protective beach with a dune system to reduce the potential for storm damage in the communities of Atlantic City, Ventnor, Margate & Longport, NJ, and bulkheading along Atlantic City's Absecon Inlet frontage.

Beach Fill	
Volume of Initial Fill	6,174,013 yd^3
Volume of Renourishment Fill	1,666,000 yd^3
Interval of Renourishment	3 yrs
Length of Fill	42,825 l.f.
Width of Beach Berm (Atlantic City)	200 ft.
Width of Beach Berm (Ventnor, Margate & Longport)	100 ft.
With of Dune Crest	25 ft.
Timber Bulkheads with Stone Revetment	
Oriental Avenue to Atlantic Avenue	1,050 l.f.
Madison Avenue to Melrose Avenue	550 l.f.
Elevations	
Dune Crest (Atlantic City)	+16 ft. NGVD
Dune Crest (Ventnor, Margate & Longport)	+14 ft. NGVD
Beach Berm	+8.5 ft. NGVD
Bulkhead Top Elevation	+14 ft. NGVD
Slopes	
Dune (Landward)	1V:5H
Dune (Seaward)	1V:5H
Beach Berm to Existing Bottom	1V:30H
Stone Revetment	1V:2H
Dune Appurtenances	
Grass Planting	91 Acres
Sand Fencing	63,675 l.f.
Vehicle Access	
Dune Walkovers	

Project Costs	
Ultimate Project Cost (Oct. 1995 P.L.)	$265,456,000
Initial Cost	$ 52,146,000
Annualized (Discounted 7.625%)	$ 8,486,000
Average Annual Benefits	
Storm Damage Reduction	$ 8,912,000
Reduced Maintenance	$ 2,000
Benefits During Construction	$ 479,000
Recreation	$ 6,963,000
Benefit/Cost Ratio	1.9
Cost Apportionment (First Cost)	
Federal	$33,896,000
Non-Federal	$18,251,000

NOTE: All elevations referenced to the National Geodetic Vertical Datum (NGVD), 1929

INTRODUCTION

1. The New Jersey Shore Protection Study is an ongoing study of the shore protection and water quality problems facing the entire ocean coast and back bays of New Jersey. The study will provide recommendations for future actions and programs to reduce storm damage, minimize the harmful effects of shoreline erosion, and improve the information available to coastal planners and engineers to preclude further water quality degradation of the coastal waters. This report presents the formulation of the National Economic Development (NED) plan for the first interim study of the Brigantine Inlet to Great Egg Harbor Inlet Feasibility Study. This interim study focuses on Absecon Island.

2. This document was prepared in accordance with ER 1105-2-100 (Civil Works Planning Guidance Notebook), ER 1110-2-1150 (Engineering & Design for Civil Works Projects), ER 1165-2-130 (Federal Participation in Shore Protection) and other applicable guidance and regulations. The guidelines for planning water and related land resources activities as contained in the Civil Works Planning Guidance Notebook, require that Federal water resources activities be planned for achieving the National Economic Development (NED) objective. The NED objective is to increase the value of the Nation's output of goods and services and improve national economic efficiency, consistent with protecting the Nation's environments pursuant to national environmental statutes, applicable executive orders and other Federal planning requirements.

3. Due to the level of detail included in the engineering appendix, and the fact that construction of the proposed project is not complex, a General Design Memorandum (GDM) should not be required. Therefore, it is expected that this study will progress directly into the Plans and Specifications (P&S) phase.

STUDY AUTHORITY

4. The New Jersey Shore Protection Study was authorized by resolutions adopted by the Committee on Public Works and Transportation of the U.S. House of Representatives and the Committee on Environment and Public Works of the U.S. Senate in December 1987.

5. The Senate resolution adopted by the Committee on Environment and Public Works on December 17, 1987 states:

> "that the Board of Engineers for Rivers and Harbors, created under Section 3 of the Rivers and Harbors Act, approved June 13, 1902, be, and is hearby requested to review existing reports of the Chief of Engineers for the entire coast of New Jersey with a view to study, in cooperation with the State of New Jersey, its political subdivisions and agencies and instrumentalities thereof, the changing coastal processes along the coast of New Jersey. Included in this study will be the development of a physical, environmental, and engineering database on coastal area changes and

> processes, including appropriate monitoring, as the basis for actions and programs to prevent the harmful effects of shoreline erosion and storm damage; and, in cooperation with the Environmental Protection Agency and other Federal agencies as appropriate, develop recommendations for actions and solutions needed to preclude further water quality degradation and coastal pollution from existing and anticipated uses of coastal waters affecting the New Jersey Coast. Site specific studies for beach erosion control, hurricane protection, and related purposes should be undertaken in areas identified as having potential for a Federal project, action, or response".

6. The House resolution adopted by the Committee on Public Works and Transportation on December 10, 1987 states:

> "That the Board of Engineers for Rivers and Harbors is hearby requested to review existing reports of the Chief of Engineers for the entire coast of New Jersey with a view to study, in cooperation with the State of New Jersey, its political subdivisions and agencies and instrumentalities thereof, the changing coastal processes along the coast of New Jersey. Included in this study will be the development of a physical, environmental, and engineering database on coastal area changes and processes, including appropriate monitoring, as the basis for actions and programs to prevent the harmful effects of shoreline erosion and storm damage; and, in cooperation with the Environmental Protection Agency and other Federal agencies as appropriate, the development of recommendations for actions and solutions needed to preclude further water quality degradation and coastal pollution from existing and anticipated uses of coastal waters affecting the New Jersey Coast. Site specific studies for beach erosion control, hurricane protection, and related purposes should be undertaken in areas identified as having potential for a Federal project, action, or response which is engineeringly, economically, and environmentally feasible".

STUDY PURPOSE AND SCOPE

7. The Feasibility Study is the second of the Corps of Engineer's two-phase planning study process. The objective of the Feasibility Study is to investigate and recommend solutions to problems identified in the Reconnaissance Study and further defined herein. The Feasibility Report will accomplish the following:

a. Provide a complete presentation of the study results and findings;

b. Indicate compliance with applicable statutes, executive orders and policies; and

c. Provide a sound and documented basis for decision makers at all levels to judge the recommended solution(s).

8. This report presents the results of the analysis of existing conditions, without project conditions, plan formulation and design of the NED plan for the feasibility level study conducted pursuant to the previously mentioned resolutions. The Absecon Island interim study area was investigated to determine the magnitude, location and effect of the shoreline erosion problems. This will form the basis for Federal actions and programs to provide shoreline protection or to provide up-to-date information for state and local management of this coastal area. Specific to Absecon Island, this feasibility report will detail the following:

a. Define problems and opportunities in each problem area, and identify potential solutions,

b. Identify costs, environmental and social impacts, and economic indicators of identified potential solutions,

c. Present the recommended optimized NED plan for each problem area, and,

d. Present the Project Cooperation Agreement (PCA) responsibilities of the non-Federal sponsor.

STUDY AREA

9. The study area is located in southern New Jersey and is approximately 8 miles in length, extending from Absecon Inlet to Great Egg Harbor Inlet as seen in Figure 1. The study area encompasses Absecon Island, which is located in Atlantic County. Atlantic County consists of 23 incorporated communities and over 50 unincorporated communities.

10. Absecon Island contains the four communities of Atlantic City, Ventnor, Margate, and Longport. This island fronts the Atlantic Ocean on its southeastern length, Absecon Inlet along its northeastern inlet frontage and has extensive coastal and estuarine wetlands on its western boundary.

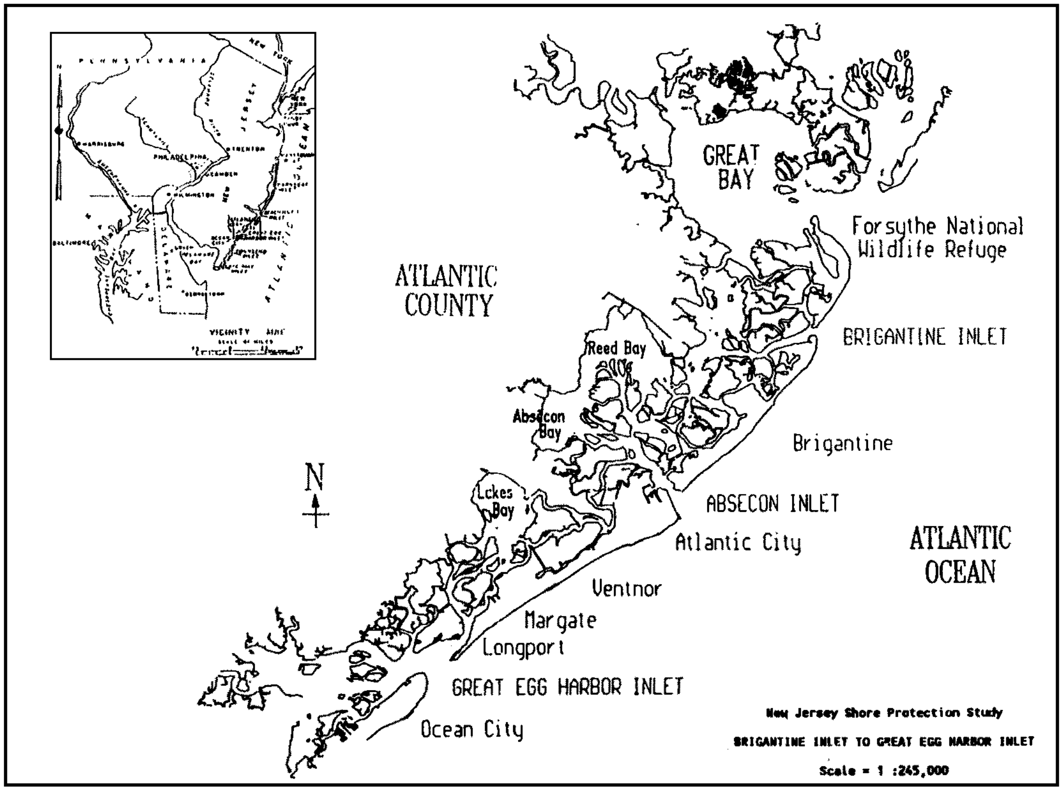


Figure 1 Brigantine Inlet to Great Egg Harbor Inlet Study Area

PRIOR STUDIES, REPORTS AND RELATED PROJECTS

11. There exist numerous planned, ongoing and completed shoreline programs and projects for the New Jersey coast. The work has been initiated by various groups including the Federal government, the State of New Jersey, municipalities, and private interests. The description and status of these projects and studies follow.

12. FEDERAL. The history of Corps involvement in the New Jersey Coast is long and intricate. Before 1930, Federal government involvement in shore erosion was limited to protection of public property. With the enactment of The River and Harbor Act of 1930 (Public Law 71-520, Section 2) the Chief of Engineers was authorized to make studies of the erosion problem in cooperation with municipal and state governments in order to devise a means of preventing further erosion of the shores. Until 1946, the Federal aid was limited to studies and technical advice. In that year, and again in 1956 (PL 84-826) and 1962 (PL 87-874), the law was amended to provide Federal participation in the cost of a project and allowed limited contribution to the protection of privately owned shores which would benefit the public. Table 1 describes recent Federal projects within the study limits.

13. The Federal navigation project at Absecon Inlet provides for an entrance channel 20 feet by 400 feet through the inlet and an entrance channel 15 feet deep with a turning basin in Clam Creek (see figure 9 later in this report).

14. Two early Federal beach erosion control projects in the study area include the Atlantic City, NJ project and the Ventnor, Margate and Longport, NJ project. The Atlantic City project was adopted as House Document 81-538 in 1954 and modified in HD 88-325 in 1962 and again in 1965. Along the Absecon Inlet frontage, the Atlantic City project included replacement of a damaged concrete seawall with a steel sheet piling wall; construction of the Brigantine Jetty; construction and extension of groins; placing revetment at the toe of an existing bulkhead; extension of the Oriental Avenue Jetty; and widening the Absecon Inlet navigation channel and maintaining this relocation by utilizing borrow material from the east side of the channel to widen the beaches along the inlet frontage. Along the ocean frontage the project included construction and extension of groins, beachfill, and periodic nourishment for a period of ten years. The project has been partially completed to include 3727 feet of the Brigantine Jetty, some groin and bulkhead work, and beachfill. The project was deauthorized on 1 January 1990 by PL 99-662.

15. The Ventnor, Margate, and Longport, NJ project was authorized by PL 86-645. This project was later modified by section 103 of the River and Harbor Act of 1962 (PL 87-874) and consists of widening 5,500 feet of beachfront, maintenance of an existing groin and periodic nourishment for a period of ten years. This project was deferred in November 1971 due to consideration of the Absecon Island project recommended in the comprehensive New Jersey Coastal Inlets and Beaches Study. The project was deauthorized on 1 January, 1990 by PL 99-662.

16. The Corps of Engineers conducted several beach erosion control and navigation studies during the 1960's and 1970's under the New Jersey Coastal Inlets and Beaches Study. The following

separate projects were included in the Barnegat Inlet to Longport House Document 94-631:

i. Barnegat Inlet
ii. Long Beach Island
iii. Brigantine Island
iv. Absecon Island

17. These projects were authorized for Phase I Design Memorandum Stage of Advanced Engineering and Design by section 101a of WRDA 1976. The projects in the study area, Brigantine Island and Absecon Island, were reauthorized pursuant to the provision of Section 605 of the Water Resources Development Act of 1986. The project for Brigantine Island includes beachfill, dunes, groins and periodic nourishment. The Absecon Island project included all features pertinent to the Absecon Inlet frontage from the Atlantic City project described above, a weir breakwater north of the Brigantine jetty, and beachfill and periodic nourishment along the oceanfront beaches. Neither of these projects have been completed however, because of the large cost associated with hard shore protection structures, and due to the predominance of recreation benefits in the original formulation. Recreation benefits are no longer a high priority output of Federal projects.

18. As stated above, section 605 of WRDA 1986 authorized the four separable projects from Barnegat Inlet to Longport, NJ. Each of the Beach Erosion Control projects had predominant recreation benefits and therefore PED was never initiated. The Barnegat Inlet project modification was constructed as a design deficiency under the authority of the Supplemental Appropriations Act of 1985 (PL 99-88) and the project's original authorization, which was the Rivers and Harbors Act of 1935 (as referred to in the executed Local Cost Sharing Agreement). Accordingly, since the authority of section 605 of PL 99-662 has not been used for funding for either PED or construction, and since section 1001 of that act deauthorizes any unfunded project authorized in WRDA 86 within five years of the date of enactment, the projects for Barnegat Inlet to Longport, NJ are considered deauthorized as of 17 November, 1991.

19. The New Jersey Shore Protection Study was initiated to investigate shoreline protection and water quality problems which exist along the entire coast. A common thread is the physical coastal processes which affect both. Physical coastal processes are those mechanisms occurring in the coastal zone which result in the movement of water, and littoral materials. It was demonstrated that existing numerical data were insufficient to formulate long term solutions, especially in the vicinity of inlets, with confidence.

20. The Limited Reconnaissance Phase of the New Jersey Shore Protection Study identified and prioritized those coastal reaches which have potential Federal interest based on shore protection and water quality problems which can be addressed by the Corps of Engineers (COE). The limited reconnaissance study report was completed in September 1990, and recommended that a reconnaissance phase study be conducted.
indicated that there was Federal interest in providing shore protection to Absecon Island and therefore the report recommended that the necessary planning and engineering studies proceed to the cost shared feasibility study.

22. Subsequently, the Feasibility Cost Sharing Agreement was signed and the study initiated in March 1993. The Absecon Island Interim Study is scheduled to be complete in December 1996. The New Jersey Department of Environmental Protection (NJDEP) is the non-Federal cost sharing sponsor.

TABLE 1
PRIOR FEDERAL ACTIONS
BRIGANTINE INLET TO GREAT EGG HARBOR INLET

AGENCY	LOCATION	AUTHORIZATION	DESCRIPTION OF PROJECT/STUDY	STATUS
USACE	Brigantine Inlet to Great Egg Harbor Inlet	Senate and House Resolutions December 1987	Shore Protection and Water Quality Study	Reconnaissance Study Report February, 1992
USACE	Coast of New Jersey, Sandy Hook to Cape May	Senate and House Resolutions December 1987	Shore Protection and Water Quality Study	Limited Reconnaissance Study Report September, 1990
USACE	Brigantine Island	HD 94-631 SEC 101a-WRDA 1976 SEC 605-WRDA 1986	Reimburse State for 7 groins Construct new groin Construct dune with fence & grass Raise beach Extend groin Maintain existing groins Periodic nourishment	Preconstruction Planning/Engineering funds never appropriated.
USACE	Absecon Island	HD 94-631 SEC 101a-WRDA 1976 SEC 605-WRDA 1986	Construct weir breakwater for sand bypassing Initial nourishment of beaches Periodic nourishment of beaches	Preconstruction Planning/Engineering funds never appropriated.
USACE	Ventnor, Margate, Longport	PL 86-645. Modified PL 87-874, 1962	Widen beach by placement of fill Maintenance of one existing groin Periodic nourishment	Deauthorized 1 Jan 90 by PL99-662
USACE	Atlantic City	HD 81-538 of 1954 HD 88-325 of 1962	Inlet frontage seawall New groins and extensions Beachfill and Periodic nourishment	Deauthorized 1 Jan 90 by PL99-662
USACE	Absecon Inlet Clam Creek	HD 67-375 of 1922 HD 76-504 of 1946	Provide entrance channel	Completed 1957; Last maintenance dredging 1978 Clam Creek dredged 1983

23. STATE. The State of New Jersey has been involved in providing technical and financial assistance to its shore towns for decades. The State officially tasked the Department of Environmental Protection (formerly The Dept. of Conservation and Economic Development) to repair and construct all necessary structures for shore protection in the early 1940's (N.J.S.A. 12:6A-1). An annual appropriation of one million dollars was established and maintained until 1977. Due to extensive destruction and erosion of the shoreline from frequent severe storms, an additional $30 million was appropriated in 1977. In addition to initiating their own research and construction efforts, the State of New Jersey also cost-shares portions of many Federal projects. In 1988 the State of New Jersey funded the COE to perform economic benefit reevaluation studies of the Federally authorized Brigantine Island and Absecon Island projects. This reevaluation determined that the previously authorized projects were still justified utilizing current COE procedures, methodologies and policy priorities.

24. The NJDEP has been involved in various areas of local shore protection along the coast of New Jersey. The Division of Coastal Resources provides technical assistance to citizens, municipalities, etc. Further, it regulates land use through the Coastal Zone Facility Review Act (CAFRA), the Wetlands Act, and the Waterfront Development Act.

25. In 1978, the legislature passed a Beaches and Harbors Bond Act (P.L., 1978, c.157) and instructed the NJDEP to prepare a comprehensive Shore Protection Master Plan in order to reduce the impacts and conflicts between shoreline erosion management and coastal development. Released in 1981, it has served as a guide to suitable alternatives for the mitigation of erosion and to develop a list of priorities among the engineering plans. Efforts were begun in 1995 to revise the Master Plan.

26. After the Halloween Storm of 1991 devastated New Jersey's shoreline, $15 million was appropriated as an amendment to the State's Economic Recovery Fund for Shore Protection. Soon thereafter, the January 1992 storm struck, overwhelming the State's fiscal resources and prompting a Presidential Disaster declaration.

27. The issue of providing stable funding for shore protection at the State level had been raised on several occasions. The two storms during the winter of 1991-92 prompted a Governor's Shore Protection Summit in February of 1992. As a result, the Shore Protection and Tourism Act of 1992 was passed which created the first ever stable source of funding for shore protection of at least $15 million annually.

28. Since 1985, the New Jersey Department of Environmental Protection has initiated several projects in the study area. Many projects involve dredging of navigation channels and discharging the material on beaches or in back bays. All of the projects under the authority of the State are tailored to address specific small scale problems and are therefore less expensive than Federal shore protection and navigation projects.

29. One such notable project is the construction of a stone revetment along Great Egg Harbor Inlet at the southern end of Longport in the fall of 1993. In response to erosion of the beach south of the 11th Avenue groin, the existing revetment was rehabilitated with 8 to 9 ton weight rough

quarrystone. The new revetment has a top width of 14 feet, a top elevation of +8.0 MLW. For more information see the Erosion Control Structure Inventory section of this report.

30. MUNICIPAL. Municipalities along the coast of New Jersey have adopted various plans in response to coastal erosion. Shore protection regulations, such as dune management are often left to the municipalities. Most municipal shore protection involvement concerns land management policies and small erosion mitigation efforts.

31. Since 1985, three larger-scale municipal improvement projects have been constructed in the study area. In the aftermath of the December 1992 storm, the Borough of Longport placed additional large stone along their back bay shoreline to reduce flooding and wave attack. The City of Atlantic City reconstructed portions of the bulkhead along Absecon Inlet. This new bulkhead is fronted by two to three ton riprap for toe protection.

32. During the summer of 1995, Atlantic City installed approximately 6000 feet of 6' X 12' woven polypropolene geotubes along portions of the oceanfront. When filled with sand, the geotubes act as the core of a dune which protects the boardwalk and other beachfront structures. For more information see the Erosion Control Structure Inventory section of this report.

33. PRIVATE. A great deal of private interest projects have taken place along the New Jersey Coast in recent years. Like municipal projects, all private ventures which take place in navigable waters of the United States and/or involve the placement of fill or structures in wetland areas must be approved by the U.S. Army Corps of Engineers.

34. Private interests are generally involved in small projects which directly affect their coastal property. In recent years, a great deal of marina and bay development activities have taken place. This is a very strong indictor of the increase in population and land use along the coastline of New Jersey. Unfortunately, because of the sporadic nature of private development, little is known regarding the interrelation and effects these small projects have on coastal processes.

RELATED INSTITUTIONAL PROGRAMS AND COORDINATION

35. Study efforts have been coordinated with agencies and organizations involved in New Jersey coastal problems including the US Environmental Protection Agency (USEPA), the Federal Emergency Management Agency (FEMA), the National Oceanographic and Atmospheric Administration (NOAA), New Jersey Department of Environmental Protection (NJDEP), New Jersey Shore and Beach Preservation Association, US Fish and Wildlife Service, Rutgers University, Lehigh University, Drexel University, Stockton State College, Atlantic County Planning Board, and the Corps' Coastal Engineering Research Center.

36. Complementary work includes coastal water quality monitoring of Atlantic County by the Atlantic County Department of Health. This work is being performed in cooperation with NJDEP. The New Jersey Beach Profiling Network instituted by NJDEP and carried out by Stockton State College provides yearly profiles for several areas in the study area. These efforts represent an important addition of information to the Philadelphia District's studies of shoreline protection and water quality.

EXISTING CONDITIONS

SOCIO-ECONOMIC RESOURCES EVALUATION

37. DESCRIPTION OF THE STUDY AREA. Absecon Island is comprised of four communities; Atlantic City, Longport, Margate and Ventnor, all of which are located within Atlantic County's 565 square miles. The study area is bordered by Absecon Inlet to the north and Great Egg Harbor Inlet to the south.

38. Atlantic County is the 6th least populated county within New Jersey with a total population of 224,327 year round residents in 1990, equalling only 2.5% of the state's permanent population. Although Atlantic County covers 565 square miles, approximately three-quarters of the residents live within five miles of the ocean. Early development along these beach front communities are currently causing slow growth trends to occur within the study area's boundaries. Despite these slow growth rates, over 85% of seasonal residents in Atlantic County are concentrated in the island communities of Atlantic City, Brigantine, Longport, Margate, Ventnor and the backbay communities of Absecon, Linwood, Northfield and Somers Point.

39. These communities rely heavily on the tourist industry for their economic stability. Although South Jersey is largely responsible for supporting the "Garden State" image, 62.9% of Atlantic County residents depend on service and sale oriented companies while only 0.42% of the work force is employed in farming, fishing or forestry.

40. <u>Atlantic City</u>. Within the county, Atlantic City is the most heavily developed community with a population of 40,199 year-round residents in 1980 and 3,347.71 people per square mile accounting for 2/3 of the study area's population. Between 1980 and 1990 however, Atlantic City experienced a decline of 5.6% lowering the population to 37,986 (see table 2). The population is expected to rise to approximately 40,450 by the year 2000 (see table 3).

41. New development has slowed over recent years. In 1991 only one new privately owned housing unit was authorized by building permits in comparison to the 39 units authorized in 1990. This is largely due to the lack of vacant land as only 6% of the total property was vacant in year 1993. Unlike the majority of the study area, Atlantic City is heavily commercialized composing 76.8% of the tax base with only 14.28% residential. Atlantic City's beaches are primarily lined with commercial buildings such as hotels, casinos, and shops, while Longport, Margate and Ventnor remain mostly residential.

42. The casinos have helped make the Atlantic City boardwalk famous while helping to attract a total of 3.2 million visitors in 1993 alone. Not only have the casinos helped the city bring in needed tourist related jobs, but they have also helped to rebuild the neighboring communities by forming an organization called the Casino Reinvestment Development Authority (CRDA). In conjunction with the CRDA, Atlantic City has planned a $42 million housing rehabilitation program, which began construction in October 1993. The program will provide 198 housing units on a 15 acre track of land

in the Inlet section of Atlantic City. Construction cost per unit is approximately $170,000, however subsidies from the CRDA will allow qualified residents to purchase the townhouses at a selling price between $70,000 and $80,000 placing it within range of the median value for single homes which was $73,400 in 1990.

43. This development represents the second phase of a $500 million redevelopment of the North-East inlet which is expected to be complete within approximately 10 years. The program will result in 2,500 new or rehabilitated housing units, commercial space and recreational areas. These renovated homes will be a great help to a city that has one of the highest unemployment rates along the Jersey shore. Atlantic City had a median household income of only $20,309 in 1989 and an unemployment rate of 5.5% with 9,208 people living below the poverty line, accounting for almost 25% of the residents.

44. The third phase of the CRDA redevelopment plan involves the construction of low-rise (townhouses) and mid-rise (approximately 100-150 units) residential structures in three tax blocks located along the Inlet frontage. CRDA has acquired the necessary property, performed site remediation, and expects construction to begin in 1996. Another major component of the Inlet renewal effort is the development of the Maine Avenue County Park. The park will extend from the waters edge to New Hampshire Avenue, a recently improved major access road. It will include ample landscaping, a pavilion, and parking area with a cove, and passive waterfront park at the waters edge.

45. The city is also planning to build a new convention center directly off the Atlantic City Expressway, and plans to have a water and amusement ride theme park serve as a gateway corridor between the new convention center and the casinos (Bally's, Caesars, and Trump Plaza). While this new development is largely on the bay, it may impact our study area by bringing more visitors to the beach.

46. Ventnor. To the south of Atlantic City is Ventnor, a resort city with a boardwalk and approximately 1.5 square miles of public beach which nearly 28,000 summer residents came to enjoy in 1993 (ssee table 2). Ventnor's population has also declined over the past decade by approximately 6% to 11,005 in 1990. It is projected that population will continue to decline by 5% until the year 2000 to a total of 10,418 (see table 3).

47. Because of the town's proximity to Atlantic City, Ventnor is also very highly developed, with a total of 5,135 residents per square mile. In 1991 there were only three building permits issued for single family units compared to 27 permits authorized in 1989. The community is primarily residential with only 2 industrial complexes and 141 commercial lots within the city's boundaries.

48. Along the boardwalk are several high rise condominium complexes and hotels. However, traveling south away from Atlantic City, the area becomes more residential with single family homes along the beach-front rather than commercial lots. The median value of a single family home was $137,700 in 1990, almost twice the value of residential homes in Atlantic City.

49. Margate. Bordering Ventnor to the south is Margate. Unlike Ventnor and Atlantic City,

Margate is more of a residential community. Margate encompasses 1.41 square miles of land. Neither Margate nor Longport have boardwalks, however all of their beaches allow public access. The beach front is almost entirely residential with only a few commercial and public buildings, including a senior citizens center and a public library. There are 6,726 total housing units, of which 45% are owner occupied. The median value for single family homes is $176,800 while median rent is $564.

50. Population has consistently declined over the last 30 years from 10,576 permanent residents in 1970 to only 8,431 in 1990 (see table 2). This trend is expected to continue into the year 2010 when it will fall to 7,315 (see table 3).

51. Like all of the cities in the study area Margate is a primarily service oriented labor force. Out of 4,563 civilian employees, 53% are service oriented with only 0.15% in the farming, fishing and forestry industry. The median income per household in 1989 was $40,649 with only 286 residents living below the poverty line (see table 4).

52. Longport. The southernmost town in the study area is Longport which lies between Margate and Great Egg Harbor Inlet. Longport is a small, quiet, residential community. The median age is 58.4 years and more than half of the residents are retired. There are no boardwalks or amusement parks to attract the younger crowd, however there are approximately 1.24 square miles of public access beaches which bring in nearly 6,000 summer residents and 1,224 year-round residents (see table 2).

53. There are 1,537 housing units with a total of 1,058 single family units and 479 multi-family units. The borough is almost completely developed with only 5% of the land remaining vacant for future development. The study area is primarily zoned for residential single family units, however there is one commercial lot and one multi-family unit along Beach Avenue. The median value for a single family home was $201,800 in 1993.

Table 2

POPULATION		
NAME	SUMMER POPULATION[1]	1990 POPULATION[2]
Atlantic County	360,132	224,327
Atlantic City	3.2 million visitors (annually)	37,986
Longport	6,000	1,224
Margate	24,000	8,431
Ventnor	28,000	11,005

Notes:
1 Based on interviews with local officials.
2 The New Jersey Municipal Data Book 1994, consistent with the 1990 Census.

54. The Atlantic County Division of Economic Development projects that Atlantic County population will increase by 9.7% between 1990 and 2000, and by 8.5% between 2000 and 2010. Within Atlantic County Longport, Margate and Ventnor are expected to grow at slow rates, while Atlantic City is expected to experience mild to moderate growth.

Table 3

PROJECTED POPULATION					
	1990	1995	2000	2005	2010
Atlantic County	224,327	233,075	246,153	256,617	267,080
Atlantic City	37,986	38,972	40,450	41,696	42,941
Longport	1,224	1,175	1,102	1,084	1,066
Margate	8,431	8,090	7,578	7,447	7,315
Ventnor	11,005	10,770	10,418	10,411	10,404

Table 4

INCOME FOR 1989				
NAME	PER CAPITA INCOME	MEDIAN HOUSEHOLD INCOME	MEDIAN FAMILY INCOME	PERSONS BELOW POVERTY
Atlantic City	12,017	20,309	27,804	9,208
Longport	23,737	34,464	45,288	107
Margate	27,939	40,649	54,949	286
Ventnor	19,038	33,120	43,414	727

Source: The New Jersey Municipal Data Book 1994 published by the U.S. Census

REAL ESTATE

55. For purposes of this report and consistent with New Jersey riparian law, the shoreline is synonymous with the mean high tide line. Areas upland of this line can be publicly or privately owned while the tidelands are by default owned by the State, unless riparian rights are granted. Easements, flood water retention, and storm damage assessment are principal reasons for determining shoreline ownership in this study, therefore ownership will be defined as the upland beach property which has frontage on the mean high water line.

56. The length of the shoreline for the 4 communities within the study area is approximately 8.3 miles. This total length is subdivided into three ownership categories: Public; which is 57.5 percent of the total length, Private with public access, which is 42.5 percent of the total length and Private with exclusive access which is zero percent. The ownership of beach front property for the cities and boroughs of Absecon Island is shown in Table 6.

57. All beachfront areas are available for access by the general public for recreational purposes. The underlying fee owners of the private areas have the right to restrict, prohibit or deny any commercial enterprises on their property.

TABLE 5
SHORELINE OWNERSHIP FOR ABSECON ISLAND

LOCATION	TOTAL ft/acreage	PUBLIC ft/acreage	PRIVATE W/Public Access ft/acreage	PRIVATE Exclusive ft/acreage
Atlantic City	17,950/82	4,350/20	13,600/62	0/0
Ventnor	9,000/41	4,800/22	4,200/19	0/0
Margate	8,550/40	8,200/38	350/2	0/0
Longport	8,400/38	7,900/36	500/2	0/0
TOTALS	43,900/201	25,250/116	18,650/85	0/0

58. The municipalities of Atlantic City and Longport are in compliance with the State of New Jersey requirement that public access and easements have been obtained along their shorefronts to enable them to be eligible for grants and/or funding associated with any future shore protection project.

GEOTECHNICAL EVALUATION

59. PHYSIOGRAPHY. The study area lies along the southern coast of New Jersey within the Coastal Plain province of eastern North America. In New Jersey, the province extends from a line through Trenton and Perth Amboy southeastward for about 150 miles to the edge of the continental shelf. The land portion of the province is bounded on the northeast by Raritan Bay and on the west and south by the Delaware Estuary. The submerged portion of the plain slopes gently southeastward at 5 or 6 feet per mile for nearly 100 miles to the edge of the continental shelf. The surface of the shelf consists of broad swells and shallow depressions with evidence of former shore lines and extensions of river drainage systems. The most prominent of these valleys is the Wilmington Canyon, which is an extension of the Delaware River drainage system off the southern portion of the New Jersey coast. The Atlantic coastal shelf is essentially a sandy structure with occasional silty or gravelly deposits. It extends from Georges Bank off Cape Cod to Florida, and it is by far the world's largest sandy continental shelf.

60. About 85 percent of the shorefront of New Jersey consists of a chain of narrow barrier beaches with elevations generally less than 20 feet above sea level. These beaches, each of which is a minimum of 7 miles in length, are separated from each other by ten tidal inlets. The remaining shorefront areas are where the sea directly meets the mainland; this occurs in a 19-mile reach of the northern and a 3-mile reach of the southern end of the New Jersey coast.

61. The New Jersey barrier beaches belong to a land form susceptible to comparatively rapid changes. Between the barrier beach and the mainland, there is an expanse of tidal marshland and water areas approximately 3 to five miles wide. The water areas include tidal lagoons or sounds, and a network of winding thorofares draining the marshland.

62. The drainage system of the New Jersey coastal plain was developed at a time when sea level was lower than at present. The subsequent rise in sea level has drowned the mouths of coastal streams. The formation of the barrier beaches removed all direct stream connection with the ocean between Barnegat Bay and Cape May. These streams now flow into lagoons formed in back of the barrier beach and their waters reach the Atlantic Ocean by way of the tidal inlets through the barrier beaches. The significance of these features of the drainage system to the problem area is that the coastal plain streams, which carry little sediment in their upper courses, lose that sediment in the estuaries and in the lagoons, and thus supply virtually no beach nourishment to the ocean front.

63. SURFICIAL DEPOSITS. The entire portion of the coastal plain draining to the study area is a sedimentary feature that developed under essentially the same set of conditions for a considerable period of geologic time. The area is capped with almost entirely unconsolidated sediments of Tertiary or more recent deposition. During Quaternary time, changes in sea level caused the streams alternately to spread deposits of sand and gravel along drainage outlets and later to remove, rework, and redeposit the material over considerable areas, concealing earlier marine formations. One of these, the Cape May formation, consisting largely of sand and gravel, was deposited during the last interglacial stage when sea level stood 30 to 40 feet higher than at present. The material was deposited along valley bottoms, grading into the estuarine and marine deposits of the former shore line. These deposits now stand as terraces along portions of the coast and form the mainland bluff at Cape May. The barrier beaches being of relatively recent origin are composed of the same material as the offshore bottom.

64. SUBSURFACE GEOLOGY. The Atlantic coastal plain consists of sedimentary formations overlying a crystalline rock mass known as the "basement". From well drilling logs it is known that the basement slopes at about 75 feet per mile from the Fall Line to a depth of more than 6,000 feet near the coast. Geophysical investigations have corroborated these findings and have permitted determination of the profile seaward to the continental slope. A short distance offshore, the basement surface drops abruptly but rises again gradually as the continental slope is approached. Overlying the basement are semi-consolidated beds of lower Cretaceous sediments. These beds vary greatly in thickness, increasing seaward to a maximum thickness of 13,300 feet then decreasing to 8,900 feet near the edge of the continental shelf. On top of the semi-consolidated material lie unconsolidated sediments of Upper Cretaceous and Tertiary formations. These materials, in relatively thin beds on the land portion of the coastal plain, increase in thickness to a maximum of 4,800 feet near the edge of the continental shelf.

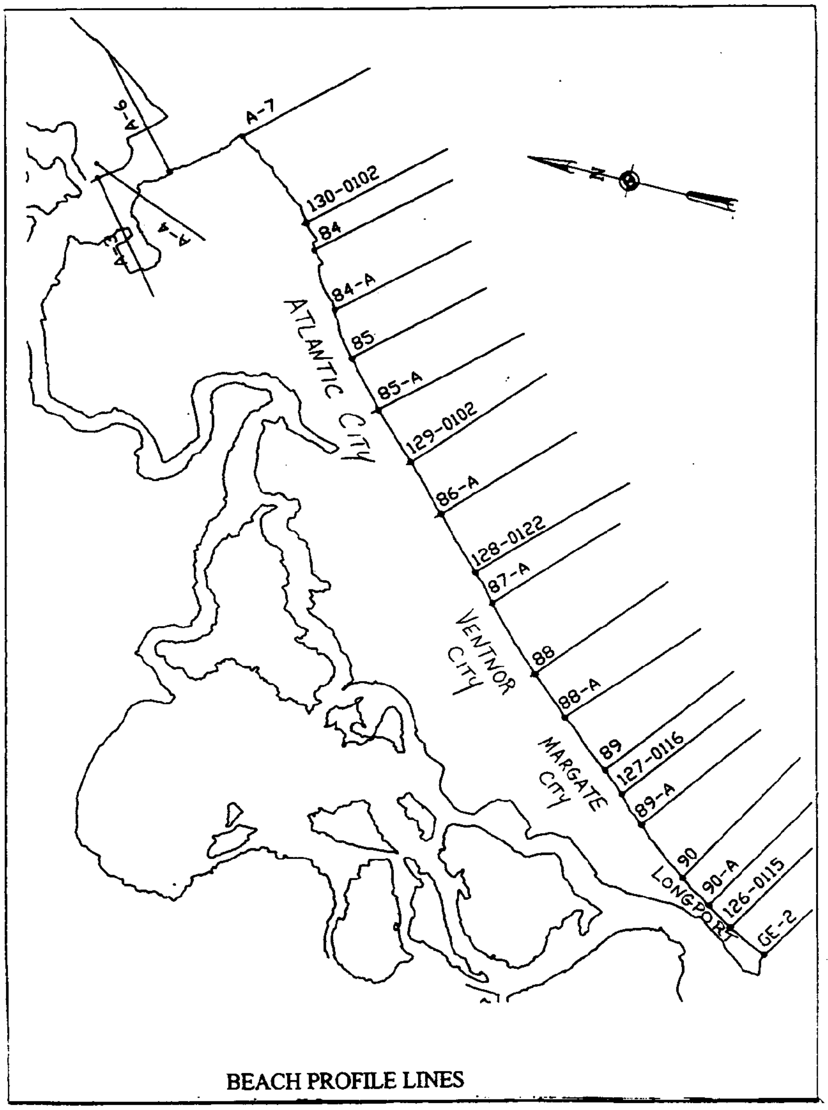
SELECTION OF BORROW MATERIAL

65. **OFFSHORE BORROW AREA INVESTIGATION.** The Reconnaissance Study report identified

several possible borrow areas for Absecon Island. In order to specifically identify sources of sand for the Absecon Island feasibility study, a series of 15 vibracores was done. The vibracores were collected by Alpine Ocean Seismic Survey, Inc. in the Atlantic Ocean off of the coast of New Jersey. The samples were collected between 12 October and 27 October 1993. The desired depth of penetration for the vibracores was 20 feet. The field work included positioning of the vessel using a DGPS navigational system, obtaining continuous core samples and obtaining penetrometer records. The field work was conducted aboard the "Atlantic Surveyor", a 110 foot offshore supply boat. The vibracores were retrieved using a model 271B Alpine pneumatic vibracorer, with an air-driven vibratory hammer. The field work was periodically inspected by Philadelphia District personnel. Sieve analysis of the sediment retrieved in the vibracores was conducted by the Army Corps of Engineers South Atlantic Division Laboratory (SAD Lab).

65a. Through the use of maps and charts which show offshore bathymetry, plans and specifications records for previous beachfill jobs, literature which included vibracore logs from previous investigations, and coordinates for overboard disposal areas of dredged material, the three proposed borrow areas in this report were identified. The three area identified as potential borrow sites include all of the sites where large deposits of sand can be found. Identification of additional sites would entail relatively large areas of potentially shallow bedded areas, resulting in the widespread disturbance of surf clam habitat, which is unacceptable to the environmental interests. The Absecon Inlet borrow area was initially identified since portions of this area had been mined previously for beachfill. The Great Egg Harbor Inlet borrow area was initially identified due to the fact that a portion of the ebb shoal was already in use supplying high-quality beachfill material for Ocean City, N.J. The offshore borrow area was initially identified as a bathymetric feature (a shoal) which would probably contain suitable beachfill material. The vibracores were then conducted for these areas to obtain sediment samples for testing and suitability analysis. The vibracore samples verified the suitability of sand within these three borrow areas for use as beachfill material for Absecon Island. All three borrow areas were then designated as possible borrow sites for the Absecon Island project. Once these areas were identified as sources of suitable beachfill material, environmental and cultural investigations were completed. The environmental field investigations consisted of benthic sampling and tows for surf clams. The results of these investigations indicated that the use of Absecon Inlet borrow area would reduce the impacts to benthic and surf clam resources, as the offshore area and Great Egg Harbor Inlet area have much higher densities of surf clams. To further lessen any impacts to surf clams, the size of the Absecon Inlet borrow area was curtailed and it was decided that the initial quantity of sand and the first few nourishment cycles would utilize this borrow site.

66. Beach Sampling. Two sets of beach samples were obtained on eight survey lines along the ocean coast of Absecon Island (see figure 2). Not all survey lines were designated for beach sampling. A distance of approximately one mile was used to determine the spacing between survey lines that were to be sampled. The survey lines that were sampled are as follows: A-7, 84-A, 129-0102, 87-A, 88-A, 89-A, 90-A and GE-2. Beach samples for both sets of sampling were collected at the following locations along each survey line: dune base, mid-berm, mid-beach, berm crest, low tide, -6 MLW, -12 MLW, and -18 MLW.



BEACH PROFILE LINES

Figure 2

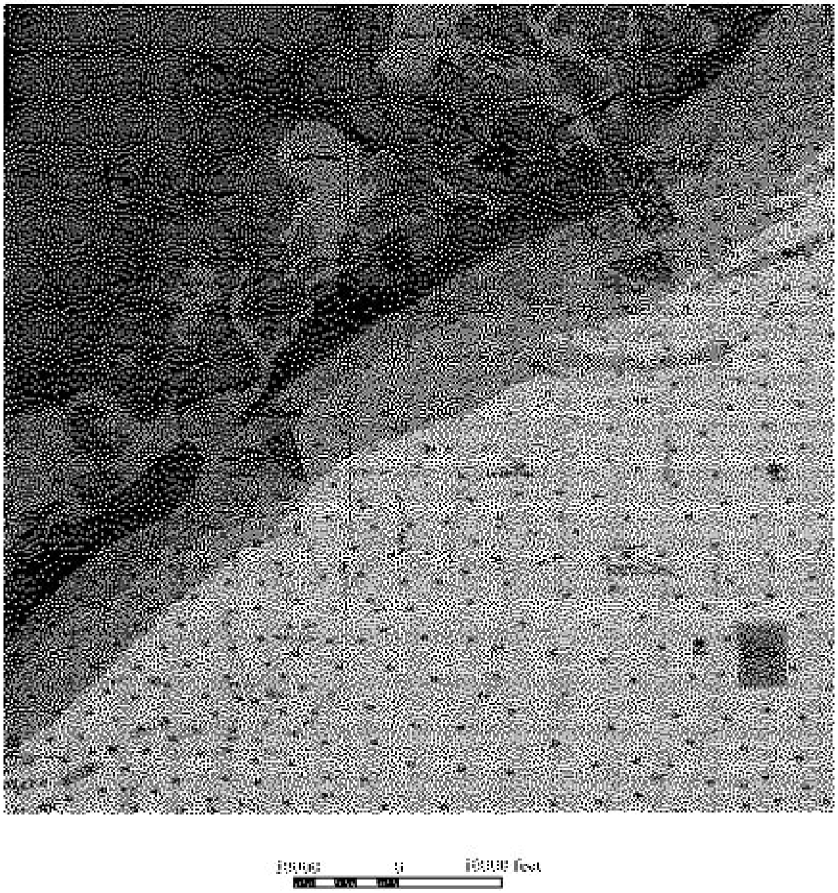
67. Borrow Area Investigation and Identification. Vibracore borings for borrow area identification were done in three specific locations. The first location was Absecon Inlet, the second location was offshore of Atlantic City, and the third location was Great Egg Harbor Inlet.

68. Vibracore Borings. The results of the vibracore investigation and analysis indicate that three potential borrow areas exist for Absecon Island (see figure 3). The first potential borrow area is the northern portion of Absecon Inlet. The second potential borrow area lies approximately 1 to 1-1/4 miles offshore of Atlantic City. The third area lies on a portion of the northern half of the Great Egg Harbor Inlet ebb shoal. All areas contains large quantities of fine sand as identified by the sieve analysis conducted by the SAD Lab.

69. Borrow Area Suitability Analysis. Ideally, borrow material should be the same size, or slightly coarser than the native material on the beach to be nourished. If the borrow material has a significantly smaller grain size, the profile will be out of equilibrium with the local wave and current environment, and will therefore be quickly eroded either offshore or alongshore. This analysis compares the native sediment characteristics to the borrow material characteristics. The analysis was completed using the methodology put forth in the Shore Protection Manual. Overfill factors (Ra) and renourishment factors (Rj) were calculated for each potential borrow area. The overfill factor estimates the volume of fill material needed to produce one cubic yard of stable beach material after equilibrium (when the beach and native materials are compatible) is reached. Consequently, overfill factors are greater or equal to one. For example, an overfill ratio of 1.2 would indicate that 1.2 cubic yards of borrow material would be required to produce 1.0 cubic yards of stable beach material. This technique assumes that both the native and composite borrow material distributions are nearly log-normal. The renourishment factor is a measure of the stability of the placed borrow material relative to the native beach sand. Desirable values of the renourishment factor are those less than or equal to one. For example, a renourishment factor of 0.33 would mean that renourishment using the borrow material would be required one third as often as renourishment using the same type of material that is currently on the beach.

70. Native Beach Characteristics. A composite beach grain size curve was developed for Absecon Island. The native mean grain size for Absecon Island is 2.36 phi units (0.19 mm) and the standard deviation in phi units is 0.82. This corresponds to a poorly graded or well sorted fine to medium sand. The following tables summarize the results of the grain size analysis including overfill and renourishment factors. The native beach conditions of a mean grain size of 2.40 phi units (0.19 mm) and a standard deviation in phi units of 0.79 were used in determining the factors. These values represent all of the beach samples with the exception of survey line A-7, which was located at the Oriental Avenue jetty and was characterized by much coarser material than was found over the rest of the island.

Absecon Island Borrow Areas



Absecon Island Borrow Areas

Figure 3

Table 6

NORTHERN PORTION OF THE GREAT EGG HARBOR EBB SHOAL (LONGPORT)

Vibracore	**Mean Grain Size in phi ($M\phi$)**	**Standard Deviation in phi ($\sigma\phi$)**	**Overfill Factor (Ra)**	**Renourishment Factor (Rj)**
NJV-135	2.86	0.88	2.0	1.7
NJV-136	3.18	0.71	8.0	3.0
NJV-138	3.42	0.58	Unstable	
NJV-139	3.05	0.76	4.0	2.5
NJV-135, 136, 138, and 139 Composite	3.13	0.77	5.0	2.8
NJV-135, 138, and 139 Composite	3.11	0.79	4.1	2.8
NJV-135, 138, and 139 Composite w/only Longport Beach Characteristics	2.86	0.88	1.7	1.6

Table 7
ABSECON INLET

Vibracore	Mean Grain Size in phi (Mϕ)	Standard Deviation in phi ($\sigma\phi$)	Overfill Factor (Ra)	Renourishment Factor (Rj)
NJV-140	1.33	1.34	1.0	0.1
NJV-143	1.61	1.70	1.1	0.1
NJV-145	3.03	0.56	Unstable	
NJV-146	2.65	0.90	1.3	1.1
NJV-140, 143, 145, and 146 Composite	2.01	1.68	1.2	0.1
NJV-143, 145, and 146 Composite	2.24	1.72	1.4	0.1

Table 8
OFFSHORE OF ATLANTIC CITY

Vibracore	Mean Grain Size in phi (Mϕ)	Standard Deviation in phi ($\sigma\phi$)	Overfill Factor (Ra)	Renourishment Factor (Rj)
NJV-147	3.19	0.66	Unstable	
NJV-148	2.94	0.74	3.6	2.1
NJV-149	3.28	0.78	7.0	3.1
NJV-150	2.99	0.88	3.0	2.0
NJV-151	2.72	0.92	1.7	1.4
NJV-152	2.59	0.87	1.2	1.2
NJV-148, 151, and 152 Composite	2.76	0.86	1.6	1.4

71. Based on the information presented in the tables above, it appears that a borrow area in Absecon Inlet (NJV-143, 145 and 146) could provide compatible sand with the least amount of overfill (Ra=1.4) and the longest renourishment cycle (Rj=0.1). Another potential borrow area is located approximately 1 to 1 1/4 miles offshore of Atlantic City (cores NJV-148, 151 and 152). However, the use of this borrow area would require a larger amount of overfill (Ra=1.6) and would have a more frequent renourishment cycle (Rj=1.4) than the Absecon Inlet borrow area. Using the Great Egg Harbor Ebb shoal for beach fill (NJV-135, 138 and 139) would also require a larger amount of fill than from the Absecon Inlet borrow area, however, this borrow area would be suitable to fill the Longport area (Ra=1.6 and Rj=1.4).

72. The Absecon Inlet borrow area is approximately 345 acres in size and is estimated to contain approximately 8.5 million cubic yards of sand. The borrow area offshore of Atlantic City is 218 acres in plan view and contains approximately 6 million cubic yards of sand. The Longport borrow area is approximately 190 acres in size and is estimated to contain approximately 5 million cubic yards of sand.

73. HAZARDOUS, TOXIC AND RADIOACTIVE WASTE ASSESSMENT. In accordance with ER 1165-2-132 entitled Hazardous, Toxic and Radioactive Wastes (HTRW) Guidance for Civil Works Projects, dated 26 June, 1992, the Corps of Engineers is required to conduct investigations to determine the existence, nature and extent of hazardous, toxic and radioactive wastes within a project impact area. Hazardous, toxic and radioactive wastes (HTRW) are defined as any "hazardous substance" regulated under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), 42 U.S.C. 9601 et seq, as amended. Hazardous substances regulated under CERCLA include "hazardous wastes" under Section 3001 of the Resource Conservation and Recovery Act (RCRA), 42 U.S.C. 6921 et seq; "hazardous substances" identified under Section 311 of the Clean Air Act, 33 U.S.C. 1321, "toxic pollutants" designated under Section 307 of the Clean Water Act, 33 U.S.C. 1317, "hazardous air pollutants" designated under Section 112 of the Clean Air Act, 42 U.S.C. 7412, and "imminently hazardous chemical substances or mixtures" that EPA has taken action on under Section 7 of the Toxic Substance Control Act, 15 U.S.C. 2606.

74. Land Use, Topography. About 85 percent of the shorefront of New Jersey consists of a chain of narrow barrier beaches with elevations generally less than 20 feet above sea level. These beaches, each of which is approximately 7 miles in length, are separated by ten inlets. The remaining shorefront from Long Branch to Bay Head and that at Cape May Point Point, is mainland of much earlier origin than the barrier islands.

75. The study area consists of the Absecon Island which is a barrier island and is bounded by Absecon Inlet to the north and Great Egg Harbor Inlet to the south. The island contains the four communities of Atlantic City, Ventor, Margate and Longport. Atlantic City is arguably the most heavily developed city on the New Jersey coast. The beachfront in Atlantic City is occupied by extensive commercial development along a world famous boardwalk. Primary among the development are the multimillion dollar casinos. The remainder of Absecon Island is also highly developed but with more standard residential and commercial establishments generally found in a beach community.

76. Preliminary Assessment. An HTRW literature search was conducted for Absecon Island by HRP Associates, Inc. for the U.S. Army Corps of Engineers Philadelphia District. The literature search identified 17 documented or potential HTRW sites in the project area, all located on Absecon Island. The 17 sites are listed below (see figure 4 for approximate locations):

	SITE	Potential/Documented HTRW
1)	U.S. Coast Guard Station	UST Leak
2)	Captain Starn's Pier	UST Leak
3)	Vacant Lot	UST Leak
4)	American Oil Company	Oil Terminal
5)	World International Hotel	UST Leak
6)	Resorts Hotel & Casino	UST Leak
7)	World Lafayette Hotel	UST Leak
8)	Offshore Area	Documented OEW Area
9)	Longport Marine	Ground Water Pollution
10)	Caesar's Hotel & Casino	UST Leak
11)	Bally's Casino	UST Leak
12)	Religious Retreat House	UST Leak
13)	Curtis Aero Station	Former Plane Repair Facility
14)	Longport Shell Gas Station	UST Leak
15)	Harrah's Marina	Ground Water Pollution
16)	Atlantic City & Shore R.R.	Former Train & Bus Repair Facility
17)	Clam Creek	Reported Fuel Spills

77. The preliminary assessment was divided into two sections. Both sections independently evaluated the impacts of the 17 potential HTRW sites listed above. The first section discusses the impacts of the sites on potential offshore borrow areas. The second section evaluates the impacts of the sites on construction which requires excavation (for example, bulkhead replacements, outfall extensions and groin construction) that may take place on Absecon Island itself.

78. Potential for Borrow Area Contamination. Three potential offshore borrow areas have been identified for Absecon Island. These three borrow areas are Absecon Inlet, a linear shoal offshore of Atlantic City, and the northern portion of Great Egg Harbor ebb shoal. A number of the sites listed above can be eliminated due to the fact that 1) there are hydraulic "disconnects" between the mainland and the borrow area (channels, inlets and general topography) and 2) no driving heads to propagate the spread of contamination. The conclusion that groundwater is not a vehicle for contaminant transport into the borrow areas can be drawn. As such, the above sites where groundwater is the main method of contaminant transport can be eliminated (all sites except 8 and 17).

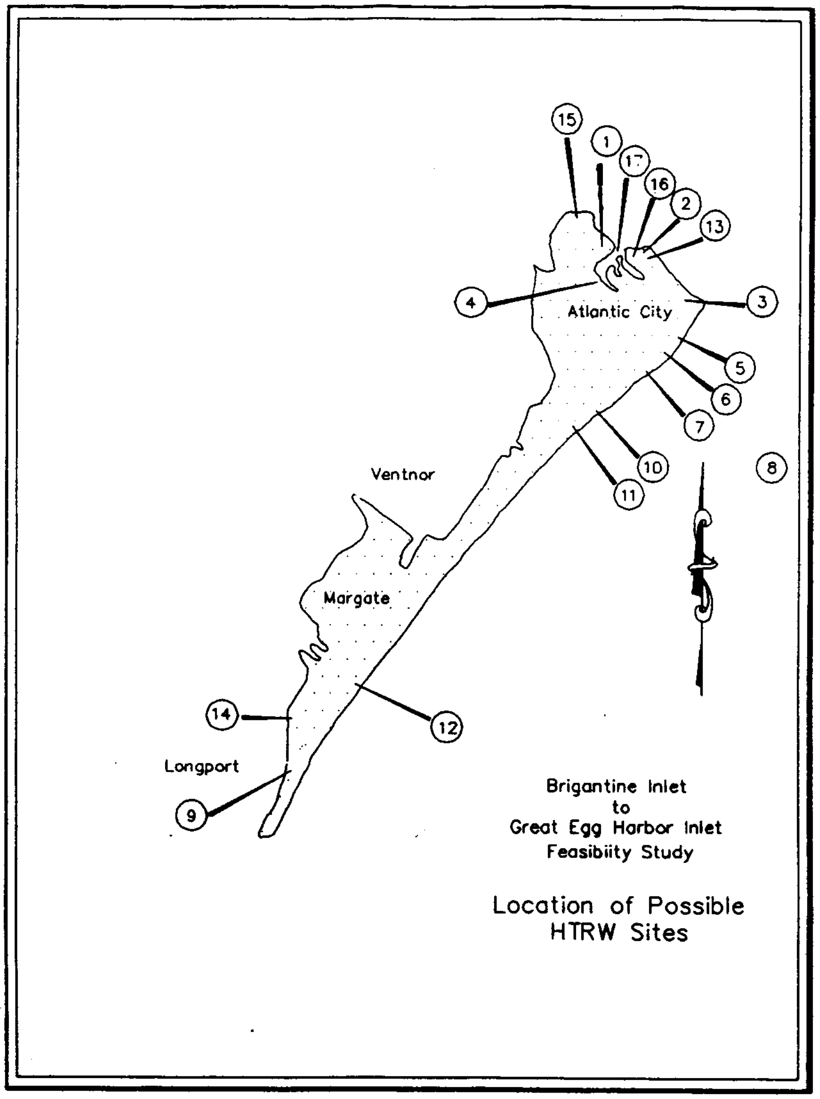

15
1
17
16
2
13
4
3
Atlantic City
5
6
7
8
10
11
Ventnor
Margate
14
12
Longport
9
Brigantine Inlet
to
Great Egg Harbor Inlet
Feasibiity Study
Location of Possible
HTRW Sites

Figure 4

79. The borrow area in Absecon Inlet is proximal to 17 - reported fuel spills in Clam Creek. The method for contaminant transport in this instance would be the tide and currents. The sediments in the borrow area are recent and are continually reworked by the offshore environment. As such it is not believed that fuel spills in Clam Creek could have any significant impact on the sediment in Absecon Inlet.

80. Lastly, the linear shoal offshore of Atlantic City is proximal to the reported location of the ordnance-explosive waste site (8). In 1961, and at this location, the U.S. Navy lost an undetermined amount of TNT charges in 27 feet of water. However, since the charges are not for underwater use and the borrow area does not intersect the area of concern shown on NOAA chart 12318, site 8, listed above can be eliminated from concern.

81. Potential for Contamination on Absecon Island. A number of potential HTRW sites were documented on Absecon Island. However, all of the sites except one may be eliminated for various reasons.

82. Sites 1, 2, 4, 15 and 16 can be eliminated due to the fact that they are beyond the project's limits. Sites 5, 6, 7, 9, 10, 11, 12, 13 and 14 can be eliminated due to the fact that the recommended plan in proximity to these sites will not include excavation and as such the project would not affect any HTRW . And lastly, sites 8 and 17 can be eliminated due to the fact that they are located offshore and as such will not be affected by landbased construction.

83. Site 3 lies near the location of a new bulkhead on Absecon Inlet, which is proposed in the selected plan. Therefore, site 3, which is curently a vacant lot with a leaking underground storage tank (LUST), was not eliminated from concern. However, excavation in this area will be minimal, especially excavation below the ground water table, which is the medium for contaminant transport in the area. For these reasons, site 3 will not be significantly impacted by a Corps of Engineers project nor will it significantly impact upon a Corps of Engineers project on Absecon Inlet. If necessary, innovative construction methods and other alternatives will be evaluated during preparation of plans and specifications which will ensure that this site will be avoided and that it will not impact the project.

ENVIRONMENTAL RESOURCES EVALUATION

84. AFFECTED ENVIRONMENT. Brigantine and Absecon Islands are separated from the mainland by 3 to 5 miles of shallow bays which include small uninhabited islands, tidal marshes, creeks and lagoons. The ground elevation of the islands is generally no more than 10 feet above mean sea level. Absecon Island is bounded by Absecon Inlet to the north and Great Egg Harbor Inlet to the south. The island contains the four communities of Atlantic City, Ventnor, Margate, and Longport. Both Brigantine and Absecon Islands front the Atlantic Ocean on their eastern boundaries and have extensive coastal and estuarine wetlands on their western boundaries.

85. Absecon Inlet lies between Brigantine Island and Absecon Island and provides a navigable

connection between the Atlantic Ocean and the harbor of Atlantic City and the New Jersey Intracoastal Waterway. The inlet is extensively used by recreational and deep draft commercial craft based behind Atlantic City. It is the most densely developed of the barrier beach islands along the New Jersey coast.

86. Absecon Island, a barrier island which has been heavily developed as a residential and recreational area, is characterized by estuarine intertidal emergent wetlands behind a marine intertidal beach/bar. A large segment of the lands to the northwest of the barrier island are classified as a backbay/coastal salt marsh system. Brigantine Island is much less developed and is primarily classified as a marine intertidal beach/bar behind which are palustrine emergent, estuarine intertidal and palustrine scrub-shrub wetlands. Common species of the beach and dune area on the barrier island system include beach grass, sea-rocket, seaside goldenrod, poison ivy, groundsel-tree, and marsh elder.

87. The backbays are comprised of open water, a low marsh zone, tidal flats, a high marsh zone, and a transition zone. The low marsh zone is typically dominated by saltmarsh cordgrass. Tidal flats are areas that are covered with water at high tide and exposed at low tide. They are important areas for algal growth, as producers of fish and wildlife organisms, and as nursery areas for many species of fish, mollusks and other organisms. Dominant species include sea lettuce and eelgrass. The high marsh zone, which is slightly lower in elevation than the transition zone is dominated by saltmeadow cordgrass and salt grass. This zone is typically flooded by spring high-tide. Plants typical of the transition zone include both upland and marsh species including marsh elder, groundsel-tree, bayberry, saltgrass, sea-blite, glasswort, poison ivy, and common reed.

88. WATER QUALITY. Through the State of New Jersey's Cooperative Coastal Monitoring Program, coastal and backbay water quality is monitored by the Atlantic County Health Department and Atlantic City Health Department. Ocean and bay stations are monitored once a week from May to September for fecal coliform. According to the New Jersey Department of Environmental Protection (NJDEP) Surface Water Quality Standards (SWQS) NJAC 7:9 4.1, fecal coliform levels for ocean areas are not to exceed 50 per 100 milliliters of sample (SWQS 50). For the bay areas, fecal coliform concentrations are not to exceed 200 per 100 milliliters (SWQS 200). Eight sites in Atlantic County are also analyzed for enterococci bacteria in an effort to quantify other bacterial indicators of contamination. The following data is derived from the Coastal Cooperative Monitoring Program Annual Reports, published by the Division of Water Resources, NJDEP.

89. In 1989, 28 ocean and 15 bay stations were monitored as part of this program. Of the 570 ocean samples collected, 93 exceeded the SWQS 50 and 21 exceeded the primary contact criterion of 200 per 100 milliliters of sample (PCC 200). Thirty-six of the 272 bay samples exceeded the SWQS and PCC 200. Excessive, continuous rainfall contributed to bacterial loading from storm water pipes into the surf zone. Of the 466 samples collected from 26 ocean stations in 1988, 44 of the samples exceeded the SWQS 50 and 4 exceeded the PCC 200. In addition, 218 bay stations were monitored and 27 samples exceeded SWQS and PCC 200. In 1987, 587 ocean samples were collected and 83 samples exceeded SWQS 50 and 36 exceeded PCC 200. The ocean stations with geometric means exceeding the SWQS were located in Atlantic City. Thirty-seven of the 183 bay samples collected

from 10 bay stations exceeded SWQS and PCC 200.

90. As a result of this monitoring program, recreational beaches may be closed if two consecutive fecal coliform concentrations are above the PCC. From August 17 to 22, 1987, the entire Atlantic City beach was closed due to contaminated water flow from storm water pipes discharging to the ocean. Several possible sources of contamination into the storm sewer system were identified. In 1990, isolated beach closures occurred after rains. In contrast, 27 beach and 84 bay closings occurred in 1992. Twenty-two of the beach closings occurred immediately following five days of rain in August. Concentrations of fecal coliforms increase after rain due to the flushing effect of storm water runoff. Excessive fecal coliform concentrations or suspected sewage pollution accounted for 26 of the 27 ocean beach closings and all of the bay beach closings in 1992. In comparison, 10 ocean beach closings in 1991 were attributable to those causes. No closings due to floatable debris washups were required in 1991 or 1992.

91. The results of the Coastal Cooperative Monitoring Program have indicated that direct storm water discharge to the ocean and indirect discharge via tidal flow from the bay inlets can be correlated with increased concentrations of fecal coliform at the program stations. Compounding the storm water effect on backbay fecal coliform levels are bacterial loadings from illegal discharge of marine sanitation devices on boats, the pressure of large animal populations, and the resuspension of sediments by boat traffic and dredging.

92. Another indication of the water quality in an area can be derived from the State of New Jersey's annual Shellfish Growing Water Classification Charts. Waters are classified as approved, special restricted, seasonal or prohibited for the harvesting of shellfish. In general the poorest water quality areas are located in the nearshore environment of the heavily populated Atlantic City and the backbay harbors and thorofares where circulation and flow is restricted on either one or both ends. The near shore waters from Absecon Inlet to Ventnor City are condemned for the harvest of oysters, clams and mussels. The waters of Absecon Inlet are seasonal/special restricted. Seasonal areas are condemned for the harvest of shellfish except during certain times while special restricted areas are condemned for the harvest of shellfish except for further processing under special permit. The backbays extending from Absecon Inlet to Great Egg Harbor Inlet are for the most part seasonal or special restricted. A few isolated thorofares and harbors are classified as prohibited.

93. WETLAND RESOURCES. The study area encompasses both the barrier island and back bay/coastal salt marsh systems. Absecon Island, a barrier island which has been heavily developed as a residential and recreational area, is characterized by estuarine intertidal emergent wetlands behind a marine intertidal beach/bar. A large segment of the lands to the northwest of the barrier island are classified as a back bay/ coastal salt marsh system.

94. Common species of the beach and dune area on the barrier island system include beach grass (Ammophila sp.), sea-rocket (Cakile edentula), seaside goldenrod (Solidago sempervirens), poison ivy (R. radicans), groundsel-tree (Baccharis halimifolia), and marsh elder (Iva frutescens).

95. The back bays are comprised of open water, a low marsh zone, tidal flats, a high marsh zone, and

a transition zone. The low marsh zone is typically dominated by saltmarsh cordgrass (Spartina alterniflora). Tidal flats are areas that are covered with water at high tide and exposed at low tide. They are important areas for algal growth, as producers of fish and wildlife organisms and as nursery areas for many species of fish, molluscs and other organisms. Dominant species include sea lettuce (Ulva lactuca) and eelgrass (Zostera marina). The high marsh zone which is slightly lower in elevation than the transition zone is dominated by saltmeadow cordgrass and saltgrass (Distichlis spicata). This zone is typically flooded by spring high-tides. Plants typical of the transition zone include both upland and marsh species including marsh elder (Iva frutescens), groundsel-tree (B. halimifolia), bayberry (Myrica spp.), saltgrass (D. spicata), sea-blite (Sueda maritima), glasswort (Salicornia spp.), poison ivy (R. radicans), and common reed (P. australis).

96. FISHERY RESOURCES. A study, conducted from March to December 1977 by John F. McClain and presented in "Studies of the Back Bay Systems in Atlantic County," indicates that the back bays of the Atlantic City area provide a high quality habitat for many species of fish. Fifty-nine species of fish, including bay anchovy (Anchoa mitchilli), weakfish (Cynoscion regalis), spot (Leiostomus xanthurus), windowpane (Scophthalmus aquosus), red hake (Urophycis chuss), winter flounder (Psuedopleuronectes americanus), small mouth flounder (Etropus microstomus), oyster toadfish (Opsanus tau) and Atlantic silverside (Menidia menidia), were among the species utilizing this habitat. The fish species caught in the back bays during this study are summarized in Table 9.

97. Sampling was conducted by gill, seine and trawl. The bay anchovy was present at all trawl stations and dominant in six of them while the seine samples were dominated by the Atlantic silverside at all stations except one. The fish species and their relative abundance were found to be similar to those reported in studies for Great Bay and Brigantine National Wildlife Refuge, now the Forsythe National Wildlife Refuge, (Icthyological Associates, 1974 and 1975), and the Delaware Bay (Daiber, 1974). The five most abundant species were Atlantic silverside, bay anchovy, spot, mummichog (3%) and striped killifish (1%).

98. During a 1977 ichthyoplankton study, conducted by Peter Himchak and presented in "Studies of the Back Bay Systems in Atlantic County", twenty species of larval and young finfish were found to utilize the backbays in the vicinity of Atlantic City as a nursery area. These include species endemic to estuaries as well as marine species that utilize the back bays as nursery grounds. Over 80 percent of the catch was comprised of members of the Gobiidae and Engravlidae Families. Approximately 15 percent of the total catch was comprised of naked gobies (Gobiosoma bosci), Northern pipefish (Syngnathus fuscus), weakfish (Cynoscion regalis), and bay anchovies (Anchoa mitchilli).

99. From 1972 to 1975, an intensive ecological study was conducted for the proposed Atlantic Generating Station (U.S. Fish and Wildlife Service, 1991). Trawl surveys between Holgate Peninsula and the Brigantine Inlet collected 69 species in 1972, and 76 species in 1973 and 1974. The most abundant fish taken for all years included bay anchovy (Anchoa mitchilli), red hake (Urophycis chuss), windowpane flounder (Scophthalmus aquosus), weakfish (Cynoscion regalis), spotted hake (Urophycis regia), and silver hake (Merluccius bilinearis).

Table 9.
Fish Species Caught in the Back Bays of Atlantic City
March-December 1977.

Species	Scientific Name
Haddock	Melanogrammus aeglefinus
Mummichog	Fundulus heteroclitus
American Sand Lance	Ammodytes americanus
Black sea bass	Centropristis striata
Northern pipefish	Syngnathus fuscus
White Hake	Urophycis tenuis
Spot	Leiostomus xanthurus
Striped sea robin	Prionotus evolans
Weakfish	Cynoscion regalis
Winter flounder	Psuedopleuronectes americanus
Striped killifish	Fundulus majalis
American eel	Anguilla rostrata
Northern sea robin	Prionotus carolinus
Smallmouth flounder	Etropus microstomus
Striped mullet	Mugil cephalus
Striped anchovy	Anchoa hepsetus
Atlantic menhaden	Brevoortia tyrannus
Spotted hake	Urophycis regius
Northern stingray	Dasyatis sp.
American shad	Alosa sapidissima
Banded killifish	Fundulus diaphanus
Threespine sticklebak	Gasterosteus aculeatus
Permit	Trachinotus falcatus
Crevalle jack	Caranz hippos
Fourspine stickleback	Apeltes quadracus
Orange filefish	Aluterus schoepfi
Pollock	Pollachius virens
Bay anchovy	Anchoa mitchilli
Cunner	Tautogolabrus adspersus
Northern puffer	Sphoeroides maculatus
Smooth dogfish	Mustelus canis
Striped cusk eel	Rissola marginata
Summer flounder	Paralichthys dentatus
Windowpane	Scophthalmus aquosus
Atlantic roasker	Micropogon undulatus
Red Hake	Urophycis chuss
Blueback herring	Alosa aestivalis
Lookdown	Selene vomer

Oyster toadfish	Opsanus tau
Striped burrfish	Chilomycterus schoepfi
Bluefish	Pomatomus saltatrix
Alewife	Alosa pseudoharengus
Hardtail	Caranx crysos
Hogchoker	Trinectes maculatus
White perch	Morone americana
Atlantic silverside	Menidia menidia
Sheepshead minnow	Cypinodon variegatus
White mullet	Mugil curema
Naked goby	Gobiosoma bosci

100. One hundred seventy-eight species of saltwater fishes are known to occur in waters of the nearby Peck Beach. Of these, 156 were from the nearshore waters. Of the 124 species recorded in nearby Great Egg Harbor Inlet, 28 are found in large number in offshore waters.

101. BENTHIC INVERTEBRATE RESOURCES. The diversity and composition of benthic communities are often reliable indicators of the overall quality of any particular habitat for supporting life (N.J. Bureau of Fisheries, 1979). Extensive shellfish beds, which fluctuate in quality and productivity are found in the back bays and shallow ocean waters of the study area. Surf clams (Spisula solidissima) are found offshore the barrier islands along with hard clams (Mercenaria mercenaria), blue mussel (Mytilus edulis) and blue crab (Callinectes sapidus). Since many of these animals are filter feeders and tend to bioaccumulate toxins and bacteria within their systems, bivalves are often used as indicators of water quality. Indications of this can be seen when shellfish areas are closed or have restricted harvests. In areas where this occurs, there are generally water quality or pollution problems associated with the closings.

102. Of the 83 species of benthic invertebrates identified in the vicinity of Atlantic City during a 1976 study, 15 were molluscs, 28 were crustaceans, 35 were polychaetes, and 5 were from other groups. Ampelisca abdita, an amphipod, was the dominant species and occurred at all stations. Dominant polychaetes included Streblospio benedicti, Scoloplos fragilis, and Polydora ligni.

103. The waters behind Absecon Island and in the vicinity of Absecon Inlet are seasonal or special restricted. In special restricted areas, the waters are condemned for the harvest of oysters, clams, and mussels except harvesting for further processing may be done under special permit from the New Jersey Department of Environmental Protection. Licensed clammers are allowed to relay clams to Great Bay where they cleanse themselves in its purer waters. At the northern half of the island, the waters are classified as prohibited and are condemned for the harvest of oysters, clams, and mussels from the shoreline to a distance between 0.25 miles and 2 miles. Most of Little Bay, Grassy Bay, and Reed Bay, except for isolated areas, are approved for shellfish harvest.

104. The hard clam is the most economically important shellfish of the back bays, supporting both commercial and recreational fisheries (N.J. Bureau of Fisheries, 1979). Although data on exact

locations and densities of adult hard clams within the project area is limited, they are known to be found in the intertidal and subtidal zones of bays and lower estuaries. A hard clam survey conducted in 1990 found areas with moderate (0.20 - 0.49 clams/sq. ft.) to high densities (≥ 0.50 clams/sq. ft.) in the areas behind Brigantine Island (Joseph, 1990).

105. In addition to supporting some of the best hard clam resources in the State, the bays in the project area also support other species of shellfish (N.J. Bureau of Fisheries, 1979). American oysters are not usually present in commercially harvestable densities but can be found throughout the project area. Soft clams and blue mussels are primarily harvested for recreation, but occasionally commercial densities are present (Fish and Wildlife, 1991).

106. Surf Clams. The surf clam fishery supports the largest molluscan fishery in New Jersey, accounting for, by weight, 52% of the State's total molluscan commercial landings in 1993. This catch represents over 85% of the total Mid-Atlantic area catch for 1993, with a value of over 21 million dollars (N.J. Bureau of Shellfisheries, 1994).

107. A study conducted from July, 1989 to June, 1990 surveyed the standing stock of surf clams in New Jersey (Ward, 1990). This study investigated size composition, abundance, and recruitment within the New Jersey surf clam population. In 1989, the harvest zones between Barnegat Inlet and Absecon Inlet were estimated to contain over 3 million bushels of surf clams, or 40% of the state's standing stock (Fish and Wildlife, 1991).

108. According to data from New Jersey's Bureau of Shellfisheries 1993 annual surf clam inventory project, the total surf clam standing stock for New Jersey territorial waters was 12,195,000 bushels. This number represents a decrease of 775,000 bushels from 1992. Surf clam harvest records indicate that most of the harvesting activity (42%) in New Jersey occurred in the middle mile between Absecon Inlet and Barnegat Inlet. During the 1993-1994 season, over 600,000 bushels of surf clams were harvested (N.J. Bureau of Shellfisheries, 1994).

109. The area between Little Beach and Absecon Inlet from the surf to one nautical mile off-shore has been designated a conservation zone by the Surf Clam Advisory Committee. This joint committee was formed by the N.J. Bureau of Shellfisheries and representatives of the commercial surf clam industry to determine harvesting regulations. No surf clam harvesting is allowed within a conservation zone in order to promote recruitment and growth of current stock (U.S. Fish and Wildlife Service, 1991).

110. BENTHIC SURVEYS OF MACROINVERTEBRATES. The nearshore and offshore zones of the New Jersey Coast contain a wide assemblage of invertebrate species inhabiting the benthic substrate and open water. Invertebrate phyla existing along the coast are represented by Cnidaria (corals, anemones, jellyfish), Platyhelminthes (flatworms), Nemertinea (ribbon worms), Nematoda (roundworms), Bryozoa, Mollusca (chitons, clams, mussels, etc.), Echinodermata (sea urchins, sea cucumbers, sand dollars, starfish), and the Urochordata (tunicates).

111. The diversity and composition of benthic communities are often reliable indicators of the overall

quality of any particular habitat for supporting life (New Jersey Bureau of Fisheries, 1979). Benthic macroinvertebrates are those dwelling in the substrate (infauna) or on the substrate (epifauna). Benthic invertebrates are an important link in the aquatic food chain, and provide a food source for most fishes. Various factors such as hydrography, sediment type, depth, temperature, irregular patterns of recruitment and biotic interactions (predation and competition) may influence species dominance in benthic communities. Benthic assemblages in New Jersey coastal waters exhibit seasonal and spatial variability. Generally, coarse sandy sediments are inhabited by filter feeders and areas of soft silt or mud are more utilized by deposit feeders.

112. Sampling associated with the proposed Atlantic Generating Station used clam dredges, trawls, and grab samples to survey the species composition, abundance, weight, and distribution of benthic macroinvertebrates in the vicinity of the Mullica River estuary, Great Bay, Little Egg Inlet, and the ocean from Brigantine Island to Long Beach Island and 5 miles seaward (Milstein and Thomas, 1976). Over 250 macroinvertebrate species were collected during these surveys. These species included: Aricidea jeffreyssi (paraonid polychaeta), Spiophanes bombyx (spionid polychaeta), Tellina agilis (tellinid bivalvia), Mediomastus ambiseta (capitellid polychaeta), Nephtys picta (nephtyid polychaeta), Unciola irrorata (aorid amphipoda), Paranaitis speciosa (phyllodocid polychaeta), Nucula proxima (nuculid bivalvia), and Ensis directus (solenid bivalvia).

113. In 1979, the NJ Bureau of Fisheries conducted a benthic study in the inlets from Great Bay to Great Egg Harbor Inlet to inventory benthic organisms and the composition of the sediments in which they lived. The resulting report discussed the relationship of the organisms to sediment composition as well as the condition of benthic communities in specific substrates. Although some species association was found with certain sediment types, no strong correlations between species diversity and density, and sediment composition were found (Fish and Wildlife Service, 1991).

114. In October 1994, a benthic-sediment assessment focusing on infauna species was conducted in the proposed offshore sand borrow sites located in Absecon Inlet and offshore of Absecon Inlet to establish a baseline for the benthic macroinvertebrate assemblages within the proposed borrow site. Other objectives were to identify the presence of any commercial and/or recreationally important benthic macroinvertebrates, and to identify the presence of ecologically important benthic communities within the proposed sand borrow sites. Five control areas were situated around the proposed sand borrow site "A" (Absecon Inlet) and three around borrow site "B" (offshore area) to offer comparisons with the data. Sample locations in relation to the proposed borrow site can be seen in Appendix A. The sediments inhabited by the benthic community were very sandy, with sand fractions ranging from 82.1 to 99.8 percent in area "A" and from 73.4 to 99.9 percent in area "B". Sediments from area "A" varied from poorly sorted to very well sorted. Proposed borrow area "B" sediments varied from moderately well sorted to very well sorted (Battelle Ocean Sciences, 1995).

115. The results of the benthic sampling from the 38 sample locations reveal that borrow area "A" is characterized by relatively low infaunal abundance (mean, 990 individuals/m^2) and low species diversity. Characteristic organisms included haustoriid amphipods, particularly Acanthohaustorius millsi and Protohaustorius sp. B. The archiannelid worm Polygordius was rare in this proposed borrow area. Area "B" was characterized by relatively high infaunal abundance (mean, 1700

individuals/m^2) and low species diversity. Characteristic organisms in this area included Polygordius and Protohaustorius sp. B. This study also discovered the presence of the Atlantic surfclam Spisula solidissima at mean densities of about 10-20 individuals/m^2.

116. Total macrofaunal abundance per station in area "A" ranged from 20 individuals/0.1 m^2 at three stations to 260 individuals/0.1 m^2 at one station. Mean total abundance within borrow area "A" was 99 (± 36) individuals/0.1 m^2. The contribution of major taxinomic groups varied within this area. Arthropods were the predominant component of 13 stations, contributing between 67 and 94% of the individuals present at those stations. Annelid worms were the most numerous major taxon at three stations, ranging from 47-52% of the individuals present. The abundance of the selected taxa within the areas sampled can be seen in Appendix A.

117. Differences in methodology between the present study and some published studies make direct comparison of results inappropraite. However, general comparisons are useful. Total infaunal abundance found during this study may be roughly compared to that found for an offshore sandy area near Delaware Bay. The abundance recorded for this study (approximately 1400 to 1600 individuals/m^2) are higher than those reported by Maurer et al. (1979) for Hen and Chicken Shoals. They reported abundances ranging from about 100 to 700 individuals/m^2 for stations located at depths similar to those occurring in the Absecon Inlet Area. Samples studied by Maurer et al. (1979) were rinsed over a 1.0-mm mesh sieve while the Absecon samples were rinsed over a 0.5-mm sieve, thus abundances would be expected to be lower. The relative importance of haustoriid amphipods in the benthic communities in the Absecon Inlet area mirrors that found by Maurer et al. (1979). Maurer et al. (1979) also noted that species of haustoriids generally differed in their distribution relative to the shoreline. Acanthohaustorius millsi typically occurred in the nearshore area, while Parahaustorius longimerus occurred further offshore. In the Absecon Inlet areas, both species characterized relatively nearshore stations, while Protohaustorius sp B characterized offshore stations (Battelle Ocean Sciences, 1995). The complete benthic analysis can be found in Appendix A.

118. Since the time of the 1994 benthic sampling, another borrow area was added as a potential source of sand for this beachfill. This potential borrow area is located just offshore of Great Egg Harbor Inlet. In addition, another 76 acres were added to area "A" since the original benthic surveys were done. For this reason, a second round of benthic sampling was conducted for these areas in October 1995. In addition to the benthic surveys, a surf clam survey was done for all three potential borrow areas.

119. Surf Clam Surveys. During the 1995 sampling, 13 stations were sampled within the proposed borrow areas as well as the surrounding areas. The results of this benthic analysis indicate a relatively low species richness in both borrow areas with the mean number of species not exceeding 11 in either borrow area. No significant differences were found between the borrow areas, between the borrow areas and the nearshore reference areas, or between the borrow areas and the Bight Apex area which was used as a reference (Versar, 1996). The abundance of species within the borrow areas was also relatively low, less than 2,000/m^2. Again, no statistically significant differences were detected between the borrow areas or between the borrow areas and the nearshore reference area. Total abundance in the Bight Apex area was significantly greater than in the borrow areas, by a factor of

17 to 40 (Versar, 1996). The difference is mostly due to a large abundance of a bivalve and two polychaetes in the Bight Apex area. These species are Nucula annúlata (3,970/m^2), Polygordius spp. (13,006/m^2) and Prionospio steenstrupi (5,046/m^2).

120. The Versar report concluded that, except for the presence of surf clams, no significant attributes of the benthic community at the proposed borrow areas favor the selection of one borrow area over another. Also, measures of benthic community condition did not vary substantially between the proposed borrow areas and any of the reference sites in a way that would preclude the use of the areas.

121. The surf clam survey was conducted using a commercial hydraulic clam dredge equipped with a 72 inch knife to determine the abundance of clams in each borrow area. The areas were surveyed by conducting 3 five-minute tows within each proposed borrow area. The results of these tows indicate that commercially harvestable quantities of clams exist within these areas. The highest concentration was found in area "B", where between 25 and 50 bushels of clams were collected during the 5-minute tows. The average number of clams per bushel was 156. The Great Egg Harbor borrow area "C", had numbers ranging from 11 to 40 bushels per tow, with an average of 232 clams per bushel. Potential borrow area "A" produced between 15 and 23 bushels per tow with an average of 145 clams per bushel (Versar, Inc., 1995).

122. WILDLIFE RESOURCES. Marsh complexes along the New Jersey coast provide a valuable nesting habitat for the seabird population, including the common tern (Sterna hirundo). Common species occupying dredged material disposal areas, especially older sites that have been revegetated, are the least terns (Sterna albifrons), great black-backed gulls (Larus marinus), herring gulls (Larus argentatus), and the gull-billed terns (Gelocheliodon nilotica) who seek out those sites that have reverted to saltmarsh. Since the least terns are limited to a sandy substrate, unvegetated dredged material islands provide an alternative to barrier island beach habitats. Common terns occupy marsh habitats almost exclusively while the laughing gulls are found on both marsh and disposal sites. Although extensive development and disturbance of the natural conditions of the barrier islands has made this habitat the least utilized, wading birds, such as the great egrets (Casmerodius albus), black-crowned night herons (Nycticorax nycticorax), and yellow-crowned night herons (Nyctanassa violacea), are known to inhabit the barrier islands. Snowy egrets (Leucophoyx thula), glossy ibis (Plegadis Falcinellus) and little blue herons (Florida caerulea) occupy dredged material islands. The wading birds will typically arrive in mid-March and remain until mid-fall, when they travel south.

123. The New Jersey coast in the vicinity of the study area is also known as an important wintering ground for a number of waterfowl species. Species include the Atlantic brant (Branta bernicla), black duck (Anas rubripes), Canada goose (Branta canadensis), snow goose (Chen hyperborea), widgeon (Marela americana), scaup (Aytha spp.) and scoter (Melanitta spp.). Over 35 percent of the Atlantic Flyway American black duck (A. rubripes) wintering population utilizes the coastal marshes of New Jersey.

124. A 1989 survey of the Atlantic coast of New Jersey found 14 species of colonial waterbirds nesting in 39 separate colonies in the Reeds Bay/Absecon Bay area. The survey noted that

black-crowned and yellow-crowned night heron populations have declined in the last decade, while egret, ibis, and gull populations have remained stable or increased (U.S. Fish and Wildlife Service, 1991).

125. Several species of marine mammals, such as the harbor seal (Phoca vitulina), grey seal (Halichoerus grypus), ringed seal (P. hispida), harp seal (P. groenlandica), and hooded seal (Cystophora cristata), are occasionally seen in the bay areas between December and June. Bottle-nosed dolphin (Tursiops truncatus) are commonly seen in Absecon Inlet in the summer, while striped dolphin (Stenella coeruleoalba) and harbor porpoise (Phocoena phocoena) are occasionally observed in the spring. Other marine mammals that occur in the area include right whale (Balaena glacialis), pilot whale (Globicephela macrorhynchus), pygmy sperm whale (Kogia breviceps), Atlantic white-sided dolphin (Lagenorhynchus acutus), and Risso's dolphin (Grampus griseus).

126. According to studies conducted at the Forsythe National Wildlife Refuge, mammals occurring along streams and on the marsh near woodlands, in and around the study area, include the opossum (Didelphia marsupialis), shorttail shrew (Blarina brevicauda), least shrew (Cryptotis parva), starnose mole (Condylura cristata), and masked shrew (Sorex cinereus). Bat species sighted along watercourses and in wooded areas include the little brown bat (Myotis lucifugus), silver-haired bat (Lasionycteris noctivagans), Eastern pipstrel (Pipistrellus subflavus), big brown bat (Eptescius fuscus), and red bat (Lasiurus cinereus). Upland fields and woodlands support the Eastern chipmunk (Tamias striatus), Eastern cottontail (Sylvilagus floridanus), various mice and vole species, muskrat (Ondatra zibethicus), raccoon (Procyon lotor), longtail weasel (Mustela frenata) and mink (Mustela vison). In addition, gray fox (Urocyon cinereoargenteus) and river otter (Lutra canadensis) have been identified on colonial seabird islands.

127. A number of upland and fresh water species of reptiles and amphibians occur in the study area. Common reptiles include the following turtles and snakes: the snapping turtle (Chelydra serpentina), stinkpot (Sternothaerus odoratus), Eastern mud turtle (Kinosternos subrubum), Eastern box turtle (Terrapene carolina), diamond back terrapin, Eastern painted turtle (Chrysemys picta), northern watersnake (Natrix sipedon), Eastern garter snake (Thamnophis sirtalis), Northern black racer (Coluber constrictor), and Northern redbellied snake (Storeria occipitomaculata). The redbacked salamander (Plethodon cinereus), four-toed salamander (Hemidactylium scutatum), Fowler's toad (Bufo woodhousei), Northern spring peeper (Hyla crucifer), New Jersey chorus frog (Pseudarcrus triseriata), green frog (Rana utricularia), and Southern leopard frog (Rana pipiens) are all common species of amphibians found in the area.

128. ENDANGERED AND THREATENED SPECIES. Federally designated endangered and threatened species found within the study area include the endangered bald eagle (Haliaeetus leucocephalus), peregrine falcon (Falco peregrinus), Kemp's Ridley turtle (Lepidochelys kempii), hawksbill turtle (Eretmochelys imbricata), leatherback turtle (Dermochelys coriacea) and the threatened piping plover (Charadrius melodus), green turtle (Chelonia midas), and loggerhead turtle (Caretta caretta). Peregrines utilize coastal beaches and salt marshes within the study area extensively during migration, and to a lesser extent in summer and winter. Migrating and overwintering bald eagles utilize the study area's coastal marshes where they feed on waterfowl. However, no eagles are

known to nest in the area. The highest plover use occurs on the southern tip of Brigantine Island along Absecon Inlet, and the adjacent ocean-front beaches.

129. A number of Federal or State endangered or threatened species may occur in the vicinity of the study area. Eleven threatened or endangered bird species may occur within the study area. The State endangered species occurring in the Atlantic City area include osprey (Pandion haliaetus), least tern (Sterna albifrons), and black skimmer (Phynchops nigra). The Federally endangered peregrine falcon (Falco peregrinus), and bald eagle (Haliaeetus leucocephalus), along with the State endangered Cooper's hawk (Accipiter cooperi) are migrant species. The State threatened species include marsh hawk (Circus hudsonius) and short-eared owl (Asio flammeus) as winter residents, the pied-billed grebe (Podilymbus podiceps) and great blue heron (Ardea herodias) as both winter and summer residents, and the migrant merlin (Falco columbarius).

130. Several species of threatened or endangered sea turtles and whales occur in the coastal and nearshore waters of the study area, although all are transients. The endangered hawksbill turtle (Eretmochelys imbricata), leatherback turtle (Dermochelys coriacea), and Atlantic ridley turtle (Lepidochelys kempii), and the threatened loggerhead turtle (Caretta caretta), green turtle (Chelonia mydas) are five species of sea turtles believed to occur in the nearshore waters of the Atlantic Ocean and bay waters. Six species of endangered whales migrate through the North Atlantic and may be found off the coast of New Jersey. These are the blue whale (Balaenoptera physalus), finback whale (Balaenoptera physalus), humpback whale (Megaptera novaeangliae), right whale (Eubalaena spp.), sei whale (Balaenoptera borealis), and sperm whale (Physeter catodon).

CULTURAL RESOURCES EVALUATION

131. The prehistoric occupation of New Jersey and the Atlantic Coast region has been categorized by archaeologists into three general periods of cultural development: Paleo-Indian (15,000 years before present (B.P.) - 8,500 B.P.), Archaic (8,500 B.P. - 5,000 B.P.), and Woodland (5,000 B.P. - 400 B.P.). Few Paleo-Indian sites have been located in the coastal region of New Jersey. This is partly due to the low population density and nomadic lifestyle of the people from the period, as well as from the inundation of sites by sea level rise and burial under thick layers of alluvium and modern cultural deposits.

132. The Archaic period is marked by a rise in sea level and subsequent changes in the flora and fauna. The warmer and wetter climate resulted in the reduction of open grassland and a proliferation of oak and hemlock forests. An increasingly wide range of plant and animal resources was exploited as groups migrated seasonally to take advantage of varying environmental conditions. Nearly all drainages in New Jersey show some signs of Archaic period settlement although the late Archaic phase is better represented than the early Archaic.

133. The Woodland period can be divided into Early Woodland (3,000 B.P. - 1,000 A.D.) and Late Woodland (1,000 A.D. - 1,650 A.D.) periods. The Early Woodland period is characterized by the emergence of stable and intensive estuarine and riverine adaptations, increasing cultural diversity,

increasingly sedentary lifestyle that relied more heavily on agriculture, and the introduction of pottery. Although relatively few New Jersey sites have been reported, the sites that do exist indicate a preference for estuarine and bay locations, and an emphasis on exploitation of shellfish from tidal estuaries and major saltwater bays. The Late Woodland period is the best-represented prehistoric period in New Jersey and is characterized by an increasingly sedentary lifestyle and corresponding reliance on agriculture. New Jersey sites are primarily located along major river systems although coastal areas along the bays were also used.

134. The time during which the Native American population came into contact with the Europeans is known as the Contact Period (1,650 A.D. - 1,800 A.D.). In the study area, native Americans living in Atlantic County at this time were the Lenni-Lenape Indians, who occasionally camped on Absecon Island, which they called Absegami, an Indian word for "place of the swans".

135. In 1614, Dutch sailors landed in Atlantic County and named the area and river Eyren Haven, or Little Egg Harbor, because of the number of birds' eggs they found along the banks of the river. Later the river was renamed Mullica River to avoid confusion with the Great Egg Harbor River to the south. Prior to 1852, the location of Atlantic City was an undeveloped island 5 miles off the mainland and separated from it by a series of bays, sounds, and salt meadows. Known as Absecon Island or Absecon Beach, the frequency of shipwrecks and isolation of the island made it an attractive spot for refugees from war or the law. Dr. Jonathan Pitney of Absecon, "the father of Atlantic City", was the first to see the area's possibility as a "bathing spa". In 1853, Richard Osborne mapped the bathing village and christened the area Atlantic City. The city was incorporated in 1853. Development along the bay side of Atlantic City included the 1890 improvements of Gardner's Basin. Gardner's Basin played an important role in the development of Atlantic City and was a major center for shipbuilding, commercial fishing and pleasure boating, and has contributed to life-saving activities operating out of the Absecon Inlet. The remainder of Absecon Island quickly grew with the development of Ventnor City, Margate City and Longport Borough. These municipalities constitute one of the most intensively developed seaside resort areas in the country.

136. There are numerous historic properties listed on the National Register of Historic Places within the general project vicinity. These include the Absecon Lighthouse and several hotels, apartment buildings, churches, and the Marvin Gardens Historic District. Two properties, the Atlantic City Convention Hall and Lucy, the Margate Elephant, have been designated National Historic Landmark status.

137. Over three hundred vessels have been wrecked on the shoals off Brigantine and Absecon Islands since the late 1700's. Coastal storms, treacherous northeast winds and swift tidal currents coupled with historically heavy coastal traffic has caused the documented loss of dozens of sailing vessels, steamships, barges, tugs and large modern ships off the New Jersey Coast. A variety of potential submerged cultural resources in the project vicinity could date from the first half of the seventeenth century through the Second World War. The 1990 NOAA chart and U.S.G.S. quadrangle maps for the project area show numerous shipwreck sites on the shoals and just off the shoreline.

138. The Philadelphia District conducted two cultural resources investigations for the project in

1995. In the first study, entitled "A Phase 1 Submerged and Shoreline Cultural Resources Investigation, Absecon Island, Atlantic County, New Jersey (Cox and Hunter 1995), researchers investigated two borrow areas and an eight-mile segment of tidal zone and shoreline along Absecon Island. Magnetometer, side-scan and bathymetric data analysis identified 5 potentially significant underwater resources in the Absecon Inlet Borrow Area. No targets of any kind were identified in the Offshore Borrow Area. The shoreline survey identified two historic entertainment piers that are potentially eligible for listing in the National Register of Historic Places - the Steeplechase Pier and the Garden Pier.

139. In the second study, submitted as an executive summary entitled "A Phase 1 and 2 Submerged and Shoreline Cultural Resources Investigation, Brigantine Inlet to Hereford Inlet, Atlantic and Cape May Counties, New Jersey" (Cox 1995), archaeologists conducted additional remote sensing investigations in the borrow areas at Absecon Inlet and Longport, and conducted underwater groundtruthing operations at selected high probability target locations. The remote sensing survey identified 2 additional high probability targets in the expanded Absecon Inlet Borrow Area, bringing the total to 7 high probability targets. Underwater ground truthing operations were conducted at 6 of these 7 target locations. One high probability target was not investigated during ground truthing operations. Although site conditions in the inlet limited the ability of the divers to confirm the material responsible for generating each target, a re-analysis of previously collected and newly acquired remote sensing data suggests that 4 of the 6 targets exhibit strong shipwreck characteristics. Historical research shows that one of these 4 targets, although not confirmed in the field, is the probable location of the 85 foot barge "Troy", a modern vessel that sank in the inlet in the early 1980's. Researchers recommend that five high probability targets be avoided during construction (see figure 51 in the Project Impacts section of this report.

140. No targets were found in the Longport or Offshore borrow areas during the second study.

EROSION CONTROL STRUCTURE INVENTORY

141. A site inspection of the existing coastal structures on Absecon Island was conducted in January 1994. Existing shore protection structures include timber and concrete bulkheads, concrete seawalls, stone revetments, and stone and timber beach groins. The existing condition of erosion control structures along Absecon Island are inventoried in Appendix A.

142. The bulkheads protecting Absecon Island, both along the inlet and the ocean front, are constructed of timber and concrete and conditions vary from excellent to poor. Construction of the timber bulkheads include two basic designs, which are essentially the same. Both designs require a single or double row of king piles (through a cross section) connected to a double row of timber sheet piling by means of bolted connections to a face and a lock waler. However, one design also includes an anchor pile connection.

143. The top elevation of the bulkheads vary between +10 to +15.5 MLW along the Absecon Inlet frontage, where there are two different sections of bulkhead. The new anchored bulkhead along

Maine Ave. from Caspian Ave. to Atlantic Ave. (2200 ft. in length) was constructed in 1993 and is in excellent condition. The remaining sections from Atlantic to Euclid Aves. (300 ft. in length) and those from Seaside to Metropolitan Aves. (approx. 1000 ft. in length) were constructed in 1935 and are in very poor condition. The section from Seaside to Metropolitan is buried under sand and is discontinuous in many areas.

144. In Ventnor, all timber and concrete bulkheads were constructed by private interests, and no plans for any of the concrete bulkheads exist in any state or local municipality record. There is 5300 feet or about one (1) mile of concrete bulkhead and 3400 feet of timber bulkhead in the city of Ventnor. All the concrete bulkheads were constructed between 1925 and 1935, top elevations vary between +12 to +13 MLW, top widths vary between 2 and 3 feet, and conditions range from poor to good. All the concrete bulkheads are mostly intact and continue to provide protection to beachfront properties and street ends. The timber bulkheads in Ventnor were constructed between 1950 and 1952, with approximately 500 feet being replaced following the March 1962 storm. Top elevations vary between +10 and +13 MLW. The majority are in fair condition. Short gaps in construction (less than 20 ft.) exist at the Baton Rouge, Austin, and Amherst Place street ends.

145. In Margate, the entire shorefront (8450 feet or 1.6 miles) is protected by timber bulkheads, which were built between 1957 and 1964. The newest sections of bulkhead at Granville and Rumson Avenues were replaced in 1993. Top elevations vary between +10 and +13 MLW, and the majority are in fair to good condition.

146. In Longport, the entire ocean front (1.4 miles) is protected by 4050 feet of timber bulkhead and 3300 feet of concrete seawall. There is also 55 feet of steel sheet pile bulkhead at the seaward end of 28th Ave. This bulkhead is in poor condition with significant corrosion, however, it still functions as designed. The concrete seawall is a combination curved face and stepped structure, which was originally built in 1917 and was rehabilitated in 1981, at which time the curved face was repaired and the top elevation was raised to +11.6 MLW (see photo #11 in the Engineering Appendix). When the seawall was originally constructed, the design did not include a pile support for the rear of the structure, which has resulted in the potential for a lack of stability of the wall if the fill supporting the rear of the structure should erode. A stone revetment with 18 inches of concrete void filler provides toe protection along the length of the seawall. The seawall is in fair to good condition, with some minor cracking and spalling. The structure has remained stable since 1963 and has been effective in providing protection to the properties behind it.

147. The timber bulkheads in Longport vary in top elevation from +10 to +14 MLW and the majority are in fair to good condition. The most recent section replaced was at 30th Ave. and the property just north of 30th, in 1984. Those sections at Pelham, Manor, and 31st Aves. are planned to be replaced in the near future by the State and municipality.

148. GROINS. There are currently eight (8) groins, approximately 500 feet apart, in Atlantic City along the Absecon Inlet frontage. Two timber groins were constructed by the City and State in 1930-32, and repaired and protected with stone ends in 1958. Five stone spur groins and one timber and stone groin were also constructed along the inlet by the City and State between 1946 and 1958. Also

along the inlet in Atlantic City is the Oriental Avenue jetty. It was built by the Federal Government in 1946-48 and extended in 1961-62 to its present length, and was rehabilitated by the State in 1983. All eight inlet groins and the jetty are in good condition.

149. Along the ocean coast of Absecon Island, there are a total of twenty-nine (29) beach groins. Nine are stone groins that are in good to fair condition with little or negligible displacement or loss of stone along their visible length. Several of the stone groins in Atlantic City were rehabilitated by the City and the State in 1983. The work included extending and raising the crest elevation of the Vermont Ave. groin, raising the crest elevation and filling voids in the armor with concrete at the Massachusetts Ave. groin, and construction of a new timber groin with stone extension directly adjacent to the existing structure at Illinois Ave. Eleven beach groins are constructed of timber that are in fair to poor condition, many with rotting timbers which render them permeable. It appears that the local communities are maintaining the stone groins in a more intact state than the timber groins. There are nine groins constructed of stone and timber cribbing that are in poor condition, with all but a few cases existing in a state of debris, nearly invisible. These do not appear to serve their original function, and similar structures have not been constructed since the late 1920's.

150. REVETMENTS. There are three stone revetments providing erosion protection for bulkheads and seawalls on Absecon Island. There is a new stone revetment along the length of the new timber bulkhead at Maine Avenue on the Absecon Inlet frontage. It is constructed of 2 to 3 ton stone and the slope of the revetment follows the existing slope of the sand fronting the bulkhead. There is also a stone revetment providing erosion protection along the length of the combination curved face and stepped reinforced concrete seawall which extends from 11th Ave. to 15th Ave. and then from between 23rd and 24th Aves. in the city of Longport. Top elevation of the revetment varies between +6 to +6.3 MLW and has concrete void filler in the upper 18" of stone. It is in fair to good condition.

151. Also in the city of Longport is a new stone revetment at 11th Ave., extending to the inner end of the stone groin constructed at Atlantic Ave. The crest of the revetment was constructed with a top width of 14 feet, a top elevation of +8.0 MLW, using 8 to 9 ton weight rough quarrystone. The revetment fronts an existing timber bulkhead with a top elevation varying between +10.0 and +12.0 MLW, and replaces a previous concrete block and stone revetment. The revetment was constructed by the State of New Jersey in 1993.

152. OUTFALLS. At the time of the previous structure inventory, most outfalls were intact and in fair to good condition. At the present time, the condition of some of these outfalls has degraded. In Atlantic City, all outfalls are intact up to approximately the mean low water line; however, several of the existing outfall pipes have broken off at pipe sections located in the surf zone. The existing length of these outfalls is not adequate to assure unhindered drainage for those proposed beachfill alternatives having a berm width of 200 feet or greater. Therefore, plans to extend the outfalls were developed during plan formulation. This required extending approximately 270' of 20" diameter ductile iron pipe, and 170' of 24" diameter D.I.P., with timber support systems spaced at 18 feet. 220' of 30" diameter D.I.P., and 150' of 36" diameter D.I.P. would also be extended with timber support systems spaced at 9 feet. Several outfalls in Ventnor, Margate and Longport have also suffered damage, and in some cases have sheared off completely at the bulkhead. These outfalls would also

require extention during plan folrmulation. It was assumed that outfalls in Ventnor, Margate and Longport would be replaced with 12" diameter D.I.P., for a total length of 1,650 feet, including timber support systems spaced every 18 feet.

153. BOARDWALKS. The boardwalk in Atlantic City extends from Caspian Ave. on the Absecon Inlet side around to the borough line at Jackson Ave. on the ocean frontage. The design and width of the boardwalk varies from 60 ft. wide with steel reinforced concrete girders and concrete piles (9,000 ft. in length) to a 40 ft. wide section which is a combination of timber and concrete girders and piles (6,600 ft. in length) to a 20 ft. wide section composed entirely of timber (6,700 ft. in length). The last reconstruction of the boardwalk occurred in 1993, and several major utilities including electric, storm drains and water lines are buried or strung directly underneath the decking along the boardwalk. Top of deck elevations vary from +11 to +13 MLW. The boardwalk is in fair to good condition, along the ocean frontage, with the exception of the seawardmost concrete girders from the Garden Pier to the Oriental Avenue Jetty, a distance of approximately 2,500 ft. The boardwalk along the Absecon Inlet frontage, from Atlantic Avenue to Oriental Avenue, has been repaired on frequent occasion, due to damage sustained from storm generated waves.

154. The boardwalk in Ventnor is of timber construction and is 20 ft. wide. It extends from the Atlantic City line at Jackson Ave. to Margate at Fredericksburg Ave., with a top of deck elevation varying between +12 and +13 MLW. The length is 8,750 ft and is in good condition.

155. GEOTUBES. A system of geotube reinforced dunes were constructed in Atlantic City during the summer of 1995. Geotubes have been placed in sections extending between Chelsea Avenue to Martin Luther King Boulevard and from Massachusetts to Vermont Avenues, with a total approximate length of 6,300 feet. The geotubes are supported by a base of sand, and were made of a permeable gortex material filled with a sand/water slurry. The slurry was obtained directly from the existing beach in Atlantic City at the surf zone, and at the final phase of construction, all water drained out through the geotextile skin leaving a solid tube filled with sand. The seaward edge of the geotubes is located approximately 75 ft. in front of the boardwalk. As positioned, the geotubes are 6 ft. high by 12 ft. wide, and are covered by approximately 1 ft. of sand to form a dune with a top elevation of +14.0 NGVD.

156. The geotubes were placed in areas considered to be critical to the protection of Atlantic City. During the construction of the geotube reinforced dunes, additional sand loss occurred along the already eroding beachface. Atlantic City may have exacerbated the depleted sand supply immediately seaward of the geotubes by using the beach as the borrow area.

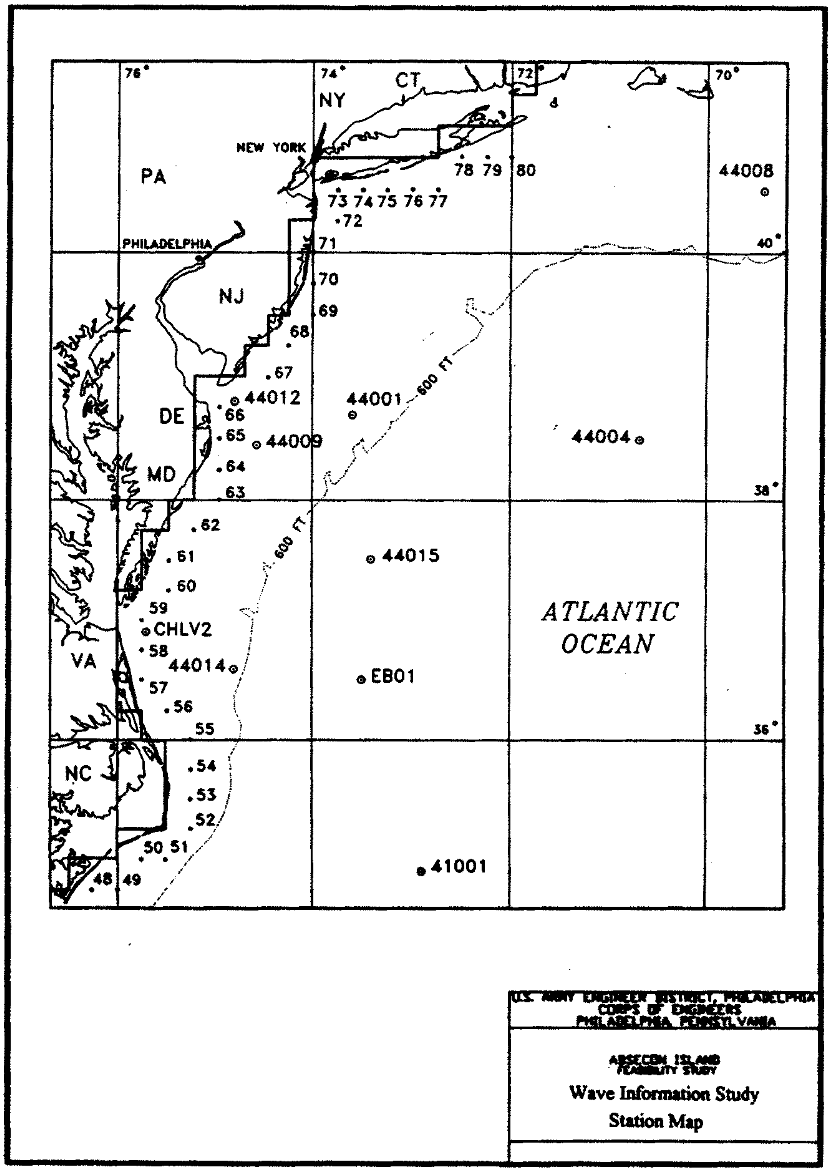
PHYSICAL PROCESSES OF THE COAST

157. A number of coastal hydraulic processes which affect the Absecon Island study area were investigated. The following paragraphs summarize these critical elements which include historic and existing wind, wave, water level and sediment conditions for the study site. A detailed discussion of historic and existing shoreline conditions, including a summary of coastal structures, is also provided.

158. WAVES. An analysis of general wave statistics for the study area is presented in a report entitled "Hindcast Wave Information for the U. S. Atlantic Coast" (Wave Information Study (WIS) Report 30) prepared by Hubertz, et al., 1993. The revised WIS data is also available digitally through the Coastal Engineering Data Retrieval System (CEDRS) developed by the U.S. Army Engineer Coastal Engineering Research Center (CERC). The wave information for each location is derived from wind fields developed in a previous hindcast covering the period 1956 through 1975 and the present version of the WIS wave model, WISWAVE 2.0 (Hubertz 1992). The WIS output results are a verified source of information for wind and wave climate along the U.S. Atlantic Coast and have been used to gain a basic understanding of the wind and wave climate at Absecon Island. The wave statistics pertinent to the Absecon Island study are those derived for Station 68 of WIS Report 30 (Figure 5). The location of Station 68 is Latitude 39.25 N, Longitude 74.25 W, in a water depth of approximately 60 ft. Monthly mean wave heights at Station 68 for the entire 20-yr hindcast range from 2.4 ft in August to 4.4 ft in December. The maximum wave height (H_{mo}) at Station 68 for the 20-yr period is reported as 22.6 ft, with an associated peak period of 14 sec and a peak direction of 86 deg on 7 March 1962. The maximum wind speed for Station 68 for the 20-yr hindcast is reported as 89 ft/sec at 20 deg on 7 March 1962.

159. Field measurements of waves at two locations have been collected by Offshore and Coastal Technologies-East, (OCTI) for the Philadelphia District during the period November 1993 to January 1995 (Figure 6). Typical plots of wave data collected are provided in Appendix A. The data collected provide bulk parameters and directional spectral information at an offshore site (approximately 35 ft depth, 8000 ft offshore) and at a nearshore site (approximately 800 ft south of Absecon Inlet in about 20 ft of water). The offshore wave measurement site is considered representative of incident wave conditions along the project area. The nearshore wave site at Absecon Inlet reasonably monitors the transformed waves reaching the Absecon Inlet/Atlantic City shoreline after passing over the ebb delta and main navigation channel. The two gages provide data needed to validate a nearshore wave transformation model used in this feasibility study. Field data have been analyzed using directional spectral analysis techniques to produce spectrally-based bulk parameters describing the wave records as well as discretized energy densities for frequency/direction bins. Time series of zero-moment wave height, peak period and mean direction are necessary from each gage to assess the performance of the nearshore wave transformation model.

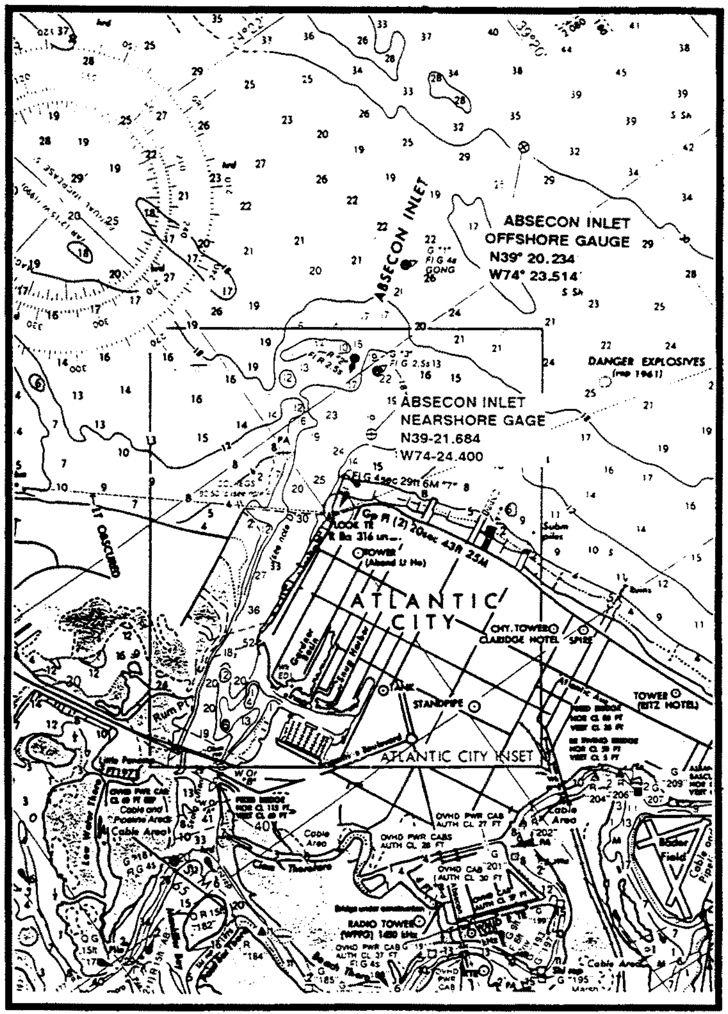
160. Wave information for use in storm erosion and shoreline change modeling was derived from two sources. First, offshore storm wave data was taken from the recent wave hindcast conducted by OCTI for the Philadelphia District. Historic storm data were generated in the hindcast using a series of numerical models applied to two storm populations. The hindcast used 15 historic hurricanes and 15 historic northeasters that have affected district coastal areas in order to formulate the storm criteria. Normal condition wave information was taken from a recent Philadelphia District hindcast of 6 years of continuous waves (1987-1993) and the 20-year WIS study. The Philadelphia District hindcast provides approximately three months of overlap with the wave gaging effort. Both data sets, generated by a directional spectral wave model, are directly compatible with the nearshore wave transformation model and provide input to shoreline change sediment transport models.



U.S. ARMY ENGINEER DISTRICT, PHILADELPHIA
CORPS OF ENGINEERS
PHILADELPHIA, PENNSYLVANIA

ABSECON ISLAND
FEASIBILITY STUDY
Wave Information Study
Station Map

Figure 5



Absecon Inlet Gauge Locations

Figure 6

161. Extreme wave statistics are available from the OCTI wave hindcast study are provided in Table 10. These offshore waves were reported by the model at 39 degrees 20 minutes North and 74 degrees 25 minutes West and are representative of waves at the 10 meter NGVD contour.

Table 10
Extreme Wave Estimates

Return Period (yr)	H_s (ft)	T_p (sec)	Mean Direction * (deg)
2	9.94	9.9	67
5	11.31	10.6	73
10	14.07	12.1	85
20	16.27	13.2	94
50	18.96	14.7	106
100	20.93	15.7	114
200	22.87	16.7	123
500	25.39	18.0	133

* Directions are from which they are coming, clockwise from north

162. WIND AND CLIMATE. The site closest to the study area for which long-term systematic wind and climatic data are available is Atlantic City. Weather data were recorded at the Absecon Lighthouse from about 1902 to 1958. In 1943, systematic weather observations were initiated at the U. S. Naval Air Station located about 10 miles northwest of the Absecon Light. Records have been made continuously at the Air Station site (presently, National Aviation Facilities Experimental Center, Pomona) to the present. In 1958, the weather observation site in Atlantic City proper was relocated from Absecon Light about 1.1 miles northwest to the Atlantic City State Marina. The station was then moved several hundred yards to the Atlantic City Coast Guard Facility.

163. The following paragraphs are quoted from the 1992 Annual Summary of Local Climatological Data, and are considered to be fully representative of conditions along Absecon Island.

> "Atlantic City is located on Absecon Island on the southeast coast of New Jersey. Surrounding terrain, composed of tidal marshes and beach sand, is flat and lies slightly above sea level. The climate is principally continental in character. However, the

> moderating influence of the Atlantic Ocean is apparent throughout the year, being more marked in the city than at the airport. As a result, summers are relatively cooler and winters milder than elsewhere at the same latitude."
>
> "Land and sea breezes, local circulations resulting from the differential heating and cooling of the land and sea, often prevail. These winds occur when moderate or intense storms are not present in the area, thus enabling the local circulation to overcome the general wind pattern. During the warm season sea breezes in the late morning and afternoon hours prevent excessive heating. Frequently, the temperature at Atlantic City during the afternoon hours in the summer averages several degrees lower than at the airport and the airport averages several degrees lower than the localities farther inland. On occasions, sea breezes have lowered the temperature as much as 15 to 20 degrees within a half hour. However, the major effect of the sea breeze at the airport is preventing the temperature from rising above the 80's. Because the change in ocean temperature lags behind the air temperature from season to season, the weather tends to remair comparatively mild late into the fall, but on the other hand, warming is retarded in the spring. Normal ocean temperatures range from an average near 37 degrees in January to near 72 degrees in August."
>
> "Precipitation is moderate and well distributed throughout the year, with June the driest month and August the wettest. Tropical storms or hurricanes occasionally bring excessive rainfall to the area. The bulk of winter precipitation results from storms which move northeastward along, or in close proximity to, the east coast of the United States. Snowfall is considerably less than elsewhere at the same latitude and does not remain long on the ground. Precipitation, often beginning as snow, will frequently become mixed with or change to rain while continuing as snow over more interior sections. In addition, ice storms and resultant glaze are relatively infrequent."

164. As referenced in the 1984 Annual Summary from the State Marina site, the prevailing winds are from the south and of moderate velocity (14 to 28 miles per hour), and winds from the northeast have the greatest average velocity (between 19 and 20 miles per hour). The wind data from this period also show that winds in excess of 28 miles per hour occur from the northeast more than twice as frequently as from any other direction.

165. The maximum five-minute average velocity at Atlantic City was recorded during the hurricane of September 1944, with a value of 82 miles per hour from the north. This storm also caused the largest recorded storm surge along the Atlantic coast of New Jersey. The fastest mile windspeed recorded at the Atlantic City Marina site over the 1960 to 1984 period was recorded during Hurricane Doria in August 1971. The fastest mile wind speed was 63 miles per hour from the southeast. The wind records generally reflect the fact that the most extreme, but infrequent, winds accompany hurricanes during the August to October period. Less extreme but more frequent high winds occur during the November to March period accompanying northeasters.

166. TIDES. The tides affecting the study area are classified as semi-diurnal with two nearly

equal high tides and two nearly equal low tides per day. The average tidal period is actually 12 hours and 25 minutes, such that two full tidal periods require 24 hours and 50 minutes. Thus, tide height extremes (highs and lows) appear to occur almost one hour (average is 50 minutes) later each day. The mean tide range for the Atlantic Ocean shoreline is reported as 4.1 feet in the Tide Tables published annually by the National Oceanic and Atmospheric Administration (NOAA). The spring tide range is reported as 5.0 feet. Absecon Channel and the back bay areas adjacent to the study area show only a small attenuation of the tide range relative to the ocean shoreline.

167. The NOAA tide gage nearest to the study area shoreline is located at the Trump Taj Mahal oceanfront pier in Atlantic City. Historically, a gage has been located on Absecon Island since July 1911. In July 1985, the gage was moved from its location at Atlantic City Steel Pier two miles south to a municipal fishing pier in Ventnor. In January 1992, the gage was moved from Ventnor to its present location at the Trump Taj Mahal Pier.

168. Water level measurements were also collected by OCTI at the offshore and inlet wave and current measurement stations at three hour sample periods. Typical plots of tidal data are provided in Appendix A.

169. CURRENTS. The Philadelphia District collected tidal current data offshore just south of the Absecon Inlet mouth from November 1993 to January 1995, with some gaps in the data due to redeployment of the instruments for a related project and weather conditions. This data includes a large set of current speed and direction measurements at a single location from a bottom mounted self-recording current meter. This data is more relevant to ocean facing shoreline parallel tidal currents than inlet currents because of the location of the current meters. The data was taken at three hour intervals. Typical plots of tidal current data are provided in Appendix A.

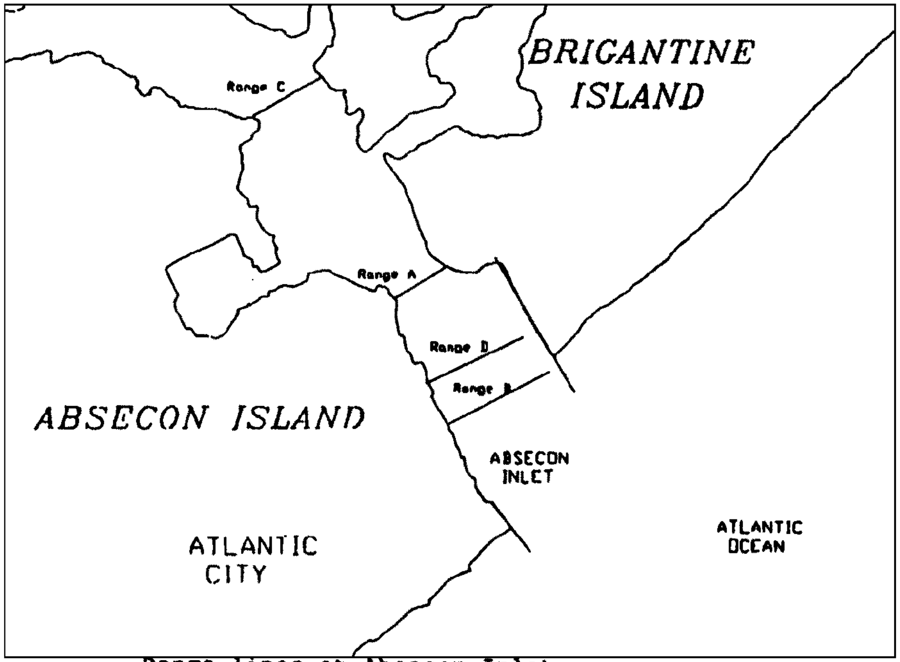
170. In addition, tidal currents and flow estimates for Absecon and Brigantine Inlets are available from a study conducted in September 1994 by CERC for the Philadelphia District. Acoustic Doppler Current Profiler (ADCP) measurements were taken at Absecon Inlet to provide estimates of depth averaged currents at specified cross-sections and flow volumes as a function of time over most of a tidal cycle. Typical plots of the current data collected are provided in Appendix A. Complete analysis results are provided in a comprehensive report entitled "Current Survey of Absecon Inlet, NJ with a Broadband Acoustic Doppler Current Profiler" available at the Philadelphia District.

171. The goal of the ADCP study was to measure the currents and discharge rates in the inlet at least every hour over a complete tidal cycle. These data were collected along four range lines (Figure 7). Range A, corresponding to channel Station 102+00, was established across the narrowest part of the inlet throat in order to capture the discharge going through the inlet. The three other ranges were established to look at current distribution across the channel. Range B starts near the Flagship Condominium near Station 76+00. Range C was established parallel to the Brigantine Bridge near Station 142+00 and Range D was established between Ranges A and B at Station 84+00.

172. There are a variety of ways to view the data collected along each of these ranges. Typical plots are provided in Appendix A. The plots show ship tracks with velocity vectors, contour plots of the velocity structure as if a slice was taken across the channel, and depth-averaged velocity plots. Time series of depth-averaged velocity and discharge estimates at each range for each transect were also developed from the data collected in this study.

173. A summary of the data collected across the inlet throat (Range A) is provided. The data indicate that during flood tide the higher water velocities are located on the south side of the channel. During ebb tide, the currents are generally uniform across the channel. During peak ebb, slightly higher velocities are concentrated on the north side of the inlet. At maximum flood, depth-averaged water velocities of over 5.6 ft/sec were measured. In general, ebb velocities were lower than the flood velocities. Typically, maximum water velocities on the ebb tide were on the order of 4.9 ft/sec. Complete analysis results for all ranges are provided in a comprehensive report entitled "Current Survey of Absecon Inlet, NJ with a Broadband Acoustic Doppler Current Profiler" available at the Philadelphia District.

174. Maximum tidal current velocities through Absecon Inlet have been previously documented as 3.1 ft/sec (U.S. Army Corps of Engineers 1943) with currents flowing past the adjacent beaches reaching maximum velocities of less than 1.0 ft/sec.



Range lines at Absecon Inlet

Figure 7

175. STORMS. Storms of two basic types present a significant threat to New Jersey's coastal zone. Hurricanes are the most severe storms affecting the Atlantic Coast. Extratropical storms from easterly quadrants, particularly the northeast, also cause extensive damage to beaches and structures along the coast.

176. Tropical storms and hurricanes, spawned over the warm low latitude waters of the Atlantic Ocean, are probably the best known and most feared storms. Hurricanes, characterized by winds of seventy-five miles per hour or greater and heavy rain, plague the Gulf and Atlantic seaboards in the late summer and autumn. Historically, the Hurricane of 1944 and Hurricane Gloria are ranked first and fifth, respectively, in terms of maximum stage at the Atlantic City gage.

177. Extratropical storms, often called "northeasters", present a particular problem to the Atlantic seaboard. Such storms may develop as strong, low pressure areas over land and move slowly offshore. The winds, though not of hurricane force, blow onshore from a northeasterly or easterly direction for sustained periods of time and over very long fetches. The damage by these storms may ultimately exceed the destruction from a hurricane. The March 1962 Northeaster ranks second only to the 1944 hurricane in terms of maximum stage. The northeasters which occurred in November 1950 and December 1992 rank third and fourth in the stage frequency analysis for the Atlantic City gage.

178. The intensity and thus the damage-producing potential of coastal storms are related to certain meteorological factors such as winds, storm track, and amount and duration of precipitation. However, the major causes of coastal damage tend to be related to storm surge, storm duration, and wave action. Storm surge and wave setup will be discussed in the storm erosion and inundation analysis included in a later section.

179. SEA LEVEL RISE. Many coastal engineers feel that sea level rise is a contributing factor to long term coastal erosion and increased potential for coastal inundation. Because of the enormous variability and uncertainty of the climatic factors that effect sea level rise, predicting future trends with any certainty is difficult. There exists many varying scenarios of future sea level rise. Corps of Engineers guidance EC-1105-2-186 states that it will be at least twenty-five years before sufficient data is collected to estimate with reasonable confidence the appropriate rate of increase or even to reach some consensus on which of the various scenarios is most likely. Until substantial evidence indicates otherwise, Corps policy specifies considering only the local regional history of sea level changes to forecast a change in sea level for a specific project area. Based on historical tide gage records between 1912 and 1986 at Atlantic City and Ventnor, New Jersey, sea level has been rising at an approximate average rate of 0.013 feet per year (Hicks and Hickman 1988). The ocean stage frequency analysis will incorporate the effects of sea level rise in the historical record. Over the proposed fifty year project life, it is assumed that sea level will rise by 0.65 feet.

180. OCEAN STAGE FREQUENCY. The stage-frequency relationship derived for this study based upon a Gumbel best-fit distribution for recurrence levels greater than a 10-yr event and based upon the Weibull best-fit distribution to annual maxima measured at Atlantic City for a 10-yr event and lower is shown in Figure 8. Values of stage at selected reference frequencies are shown in Table 11. This relationship places the maximum water level ever recorded at Atlantic City, i.e. on September 14, 1944, of 8.21 ft NGVD at the 50-yr level and the December 1992 storm peak water level of 7.42 ft NGVD at approximately a 25-yr event. Table 12 presents the 20 highest observed stages adjusted for sea level rise. The data set of ranked maximum stages measured from the Atlantic City gage is provided in Appendix A .

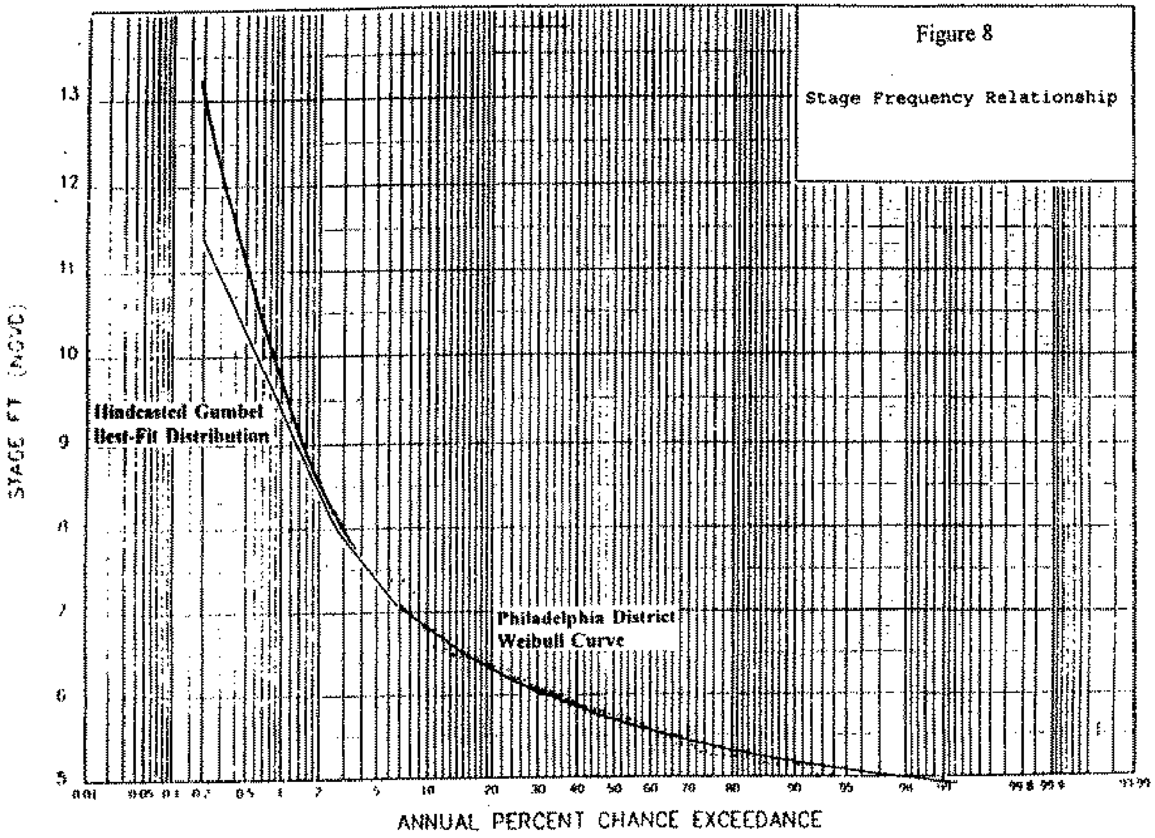


Figure 8

Stage Frequency Relationship

Table 11

Ocean Stage Frequency Data

Year Event	Annual Probability of Exceedence	Water Surface Elevation (ft, NGVD)
5	0.20	6.3
10	0.10	6.8
20	0.05	7.2
50	0.02	8.2
100	0.01	9.2
200	0.005	10.1
500	0.002	11.3

Table 12
Stage Frequency Analysis
20 Highest Stages Adjusted for Sea Level Rise
Atlantic City, NJ 1912-1994

Year	Date	Rank	Adj. Stage, NGVD	Storm Type
1944	14 Sep 1944	1	8.21	HUR
1962	7 Mar 1962	2	7.58	NE
1950	25 Nov 1950	3	7.53	NE
1992	11 Dec 1992	4	7.42	NE
1985	27 Sep 1985	5	7.39	HUR
1976	9 Aug 1976	6	7.39	HUR
1991	31 Oct 1991	7	7.23	NE
1984	29 Mar 1984	8	6.83	NE
1980	25 Oct 1980	9	6.71	NE
1953	23 Oct 1953	10	6.59	NE
1989	19 Oct 1989	11	6.50	NE
1977	14 Oct 1977	12	6.47	HUR
1947	1 Nov 1947	13	6.47	NE
1972	22 Dec 1972	14	6.45	NE
1960	12 Sep 1960	15	6.40	HUR
1961	22 Oct 1961	16	6.39	HUR
1932	10 Nov 1932	17	6.36	HUR
1935	6 Sep 1935	18	6.33	HUR
1920	5 Feb 1920	19	6.32	NE
1994	Mar 1994	20	6.30	NE

181. LONGSHORE TRANSPORT. Longshore or littoral transport can both supply and remove sand from coastal compartments. In order to determine the balance of sediment losses and gains in a system, net, rather than gross, transport rates are required. Net longshore transport refers to the difference between volume of material moving in one direction along the coast and that moving in the opposite direction.

182. The net longshore transport in the vicinity of Absecon Island is from northeast to southwest, although there is a local reversal of drift on the Atlantic City shoreline near the inlet. Observations of beach offsets at the groins taken from aerial photography and onsite observations, showed a diverging nodal zone consistently located between Garden Pier and the former Steel Pier (Sorensen, Weggel, and Douglass 1989). Table13 provides sediment transport rates which have been reported for the Absecon Island study area. The sediment budget developed for Brigantine and Absecon Islands further examines longshore transport rates in the study area.

Table13
Historic Sediment Transport Rates for Absecon Island and Vicinity

Location	Source	Gross Transport (cu yd/yr)		Net Transport (cu yd/yr)
		North	South	
Brigantine Island	CENAP House Doc #94-631 Group III	250,000	350,000	100,000 S
Absecon Inlet	CENAP Group I, II, III	500,000	600,000	100,000 S
Atlantic City	Caldwell MFR (4/18/58)	450,000	550,000	100,000 S
	Caldwell 1966 CERCR 1-67	500,000	600,000	100,000 S
Absecon Island	Wicker 1967 letter to Caldwell	107,000	199,000	92,000 S
	Caldwell 1968 letter to Wicker	250,000	400,000	150,000 S

SEDIMENT BUDGET

183. A sediment budget study is used to determine the sources, sinks and volumetric rates of material transported into and out of a particular coastal compartment over a specified time period. This study is accomplished by thoroughly investigating the various factors that influence sediment erosion, transportation, and deposition in a study area. Due to the difficulty in measuring some of these factors, reliability of a sediment budget varies depending on the characteristics of each site and quality of input data. When a sediment budget is conducted to understand the long-term change of a shoreline, a sufficient time interval must be used to average out seasonal variations.

184. Both natural trends and man-made factors (such as beach fill and coastal structures) are important parameters in a sediment budget analysis. Various factors considered as sources or credits of material include dune, cliff, and backshore erosion, beach fill, riverine sediments, eolian transport, and onshore and longshore transport. Factors considered as sinks or debits include dune and backshore storage, inlets, lagoons, overwash, dredging activities, beach mining, submarine canyons, eolian transport, and offshore and longshore transport out of the study area. A particular coastal compartment may require that many or only a few of these elements be considered in the analysis. Sediment budget assumptions and analysis techniques are discussed in a number of references including the Shore Protection Manual (1984), EM 1110-2-1502 (1992), and Meisburger (1993).

185. SEDIMENT BUDGET DATA FOR ABSECON ISLAND. A sediment budget has been developed for the length of shoreline from Brigantine Inlet to Great Egg Harbor Inlet. Several pertinent source and sink factors for the study area are discussed below.

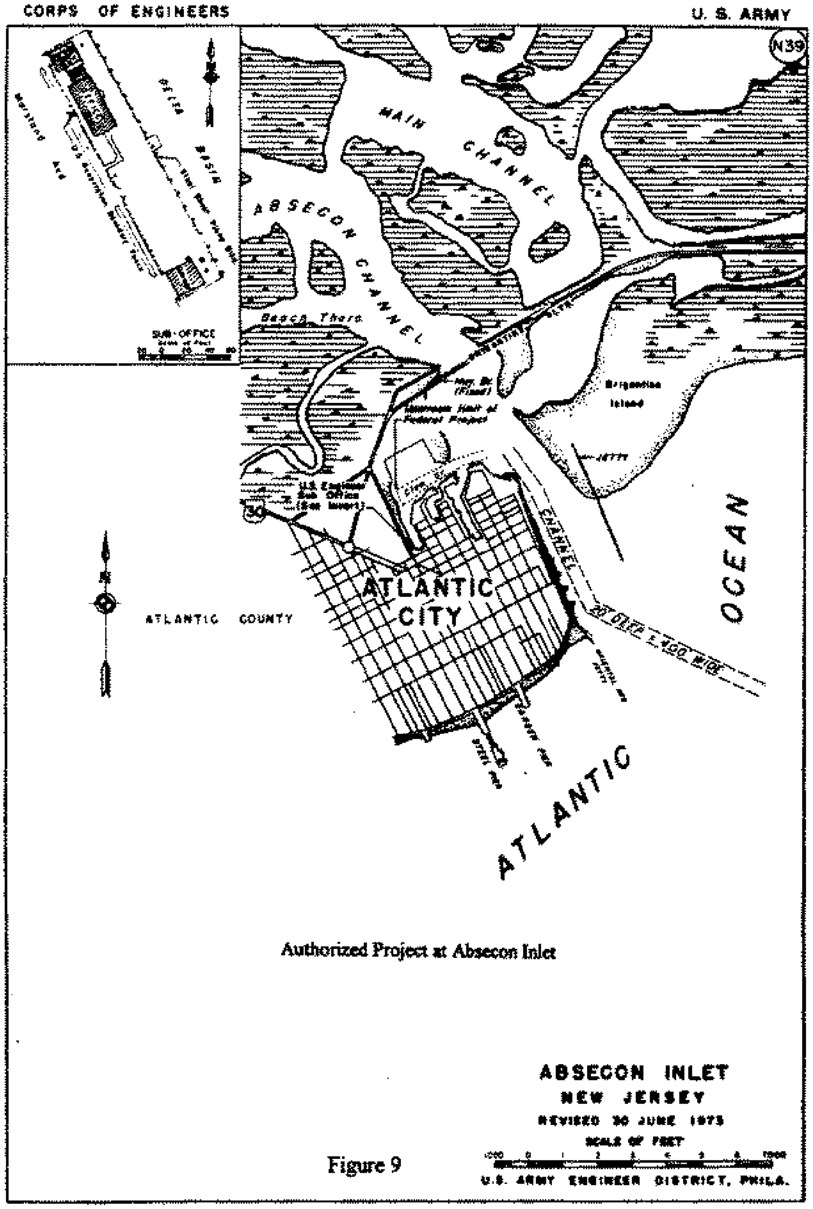
186. <u>Navigation Features.</u> The authorized project at Absecon Inlet provides for an entrance channel 20 ft deep (MLW) and 400 ft wide in the Atlantic Ocean and through the inlet, and for an entrance channel 15 feet deep into Clam Creek, with a turning basin of like depth within Clam Creek (Figure 9). The existing project was completed in 1957.

187. Structures in the vicinity of Absecon Inlet include the Brigantine jetty to the north of the inlet, the Oriental Avenue groin to the south, and 7 stone groins and a timber bulkhead along the inlet-facing shoreline of Atlantic City (see Figure 21 later in this report). These structures are not part of the authorized Federal navigation project for Absecon Inlet, but are important to processes affecting the inlet.

188. Subsequent construction of the Oriental Avenue groin, the Atlantic City inlet shoreline groins, and the Brigantine jetty have successively reduced channel and shoreline fluctuations. Southerly longshore transport has caused accretion of the Brigantine shoreline in the vicinity of the Brigantine jetty and reduction of material being bypassed to Atlantic City. Additionally, hopper dredging and offshore disposal through 1978 and the 1986 beach fill/borrow operation have decreased the volume of material in the ebb-tidal delta.

189. ABSECON INLET SHOAL VOLUME CHANGES. Bathymetry with coverage beyond the immediate area of inlet dredging, adequate to calculate changes in shoal volumes over time, includes a 1941 Corps survey, NOAA chart bathymetry from approximately 1972, and a 1994 Corps survey. The latter survey is very limited in area to the north and south of the navigation channel, limiting the area of shoal volume change calculation.

190. The volume stored by the Brigantine Jetty, built in the mid-1950s, is estimated to be approximately 1.5 million cubic yards. This includes both the fillet north of the jetty and shoals adjacent to the jetty along the northern shore of the inlet.



Authorized Project at Absecon Inlet

Figure 9

191. Inlet ebb tide shoal volume changes were calculated over an 8000 by 5000 foot area which had overlapping coverage in the three available surveys. The results show a 1.1 million cubic yard loss in the shoals from 1941 to 1972, and no appreciable shoal volume change over the limited area of common data from 1972 to 1994. Bathymetry of the inlet from 1941, 1977 and 1994 are shown in Figures 10 to 12.

192. Dredging History. Table 14 and Figure 13 provide a history of maintenance dredging in Absecon Inlet since 1915. Maintenance dredging in the inlet channel was last performed by hopper dredge in July 1978. Since 1978, controlling depths have been in the range of 17 to 19 ft MLW. These depths result from a combination of natural processes and beachfill/borrow activities. Between 1978 and 1986, the navigation channel remained sufficiently deep through natural tidal scour. However, in 1986, approximately 1,000,000 cubic yards of material was removed from the shallow areas north of the inlet navigation channel as a borrow source for an Atlantic City beachfill operation.

193. Previous analyses of dredging records indicate a range of shoaling rates dependent upon the time period analyzed. As part of the Absecon Inlet physical model study, the U.S. Army Engineer Waterways Experiment Station (1943) conducted a 10-year dredging base test of existing prototype conditions with a 400-ft wide and 20-ft deep channel. Subsequent to the initial channel cut, an average of 109,000 cu yd of material per year was dredged from the model channel to maintain project dimensions. An approximate analysis of average annual "pay place" quantities from 1970 to 1978 resulted in a maintenance dredging rate of 81,800 cu yd/year. No maintenance dredging has been required from 1978 to 1994 indicating a shoaling rate of zero cu yd/year. The inlet processes analysis conducted for this feasibility study investigated Absecon Inlet bathymetry and volumetric changes. A discussion of historic, present day, and future inlet processes are presented in a later section of this report.

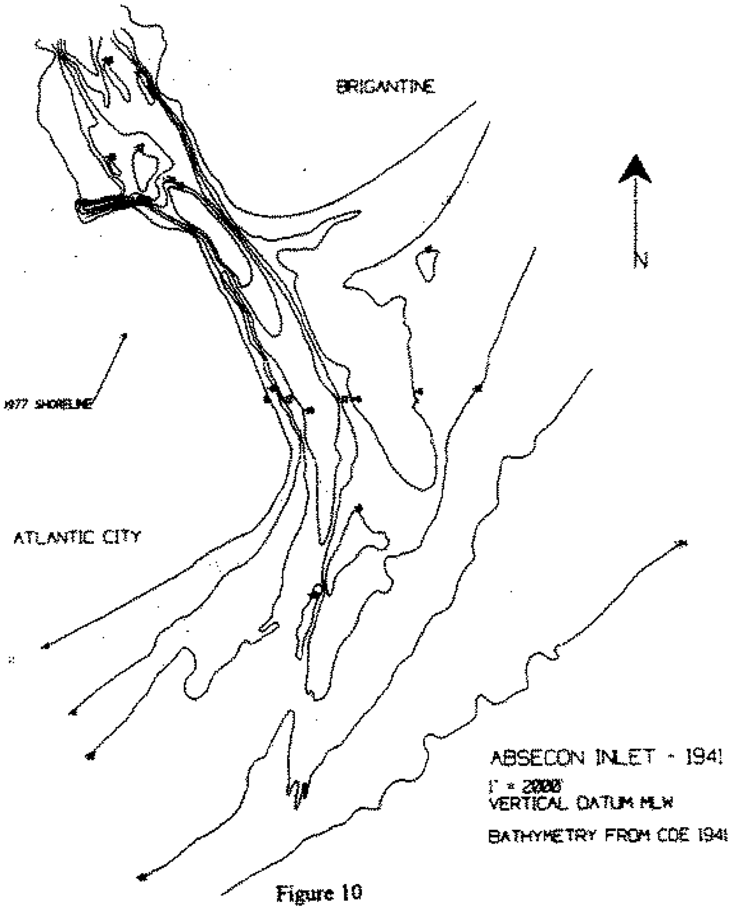


Figure 10

1941 Absecon Inlet Bathymetry

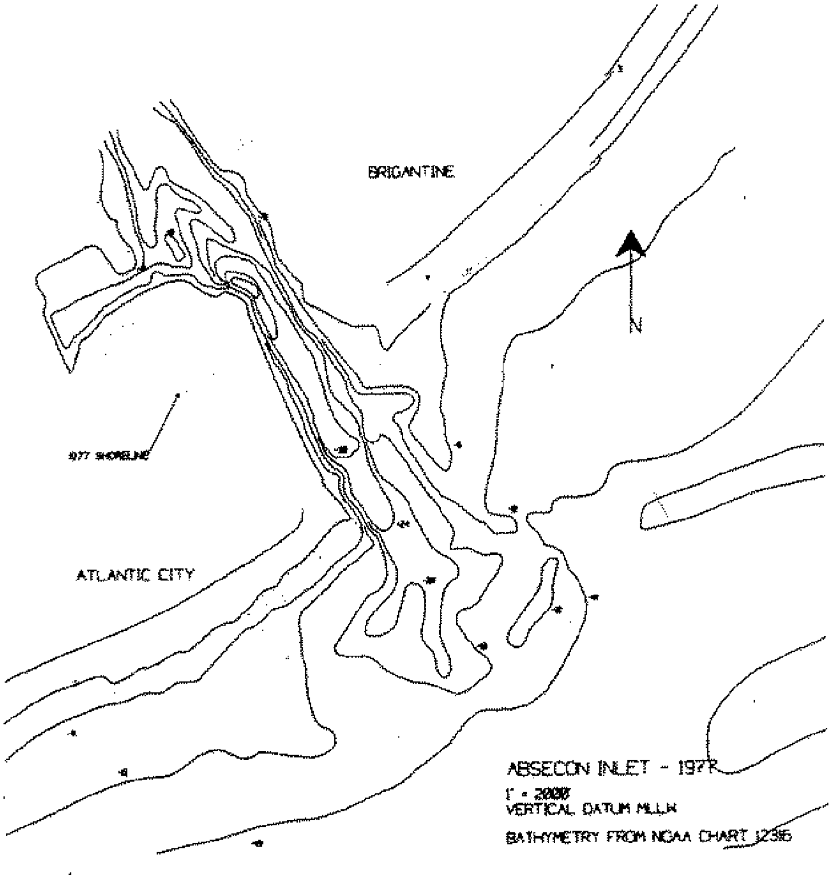


Figure 11

1977 Absecon Inlet Bathymetry

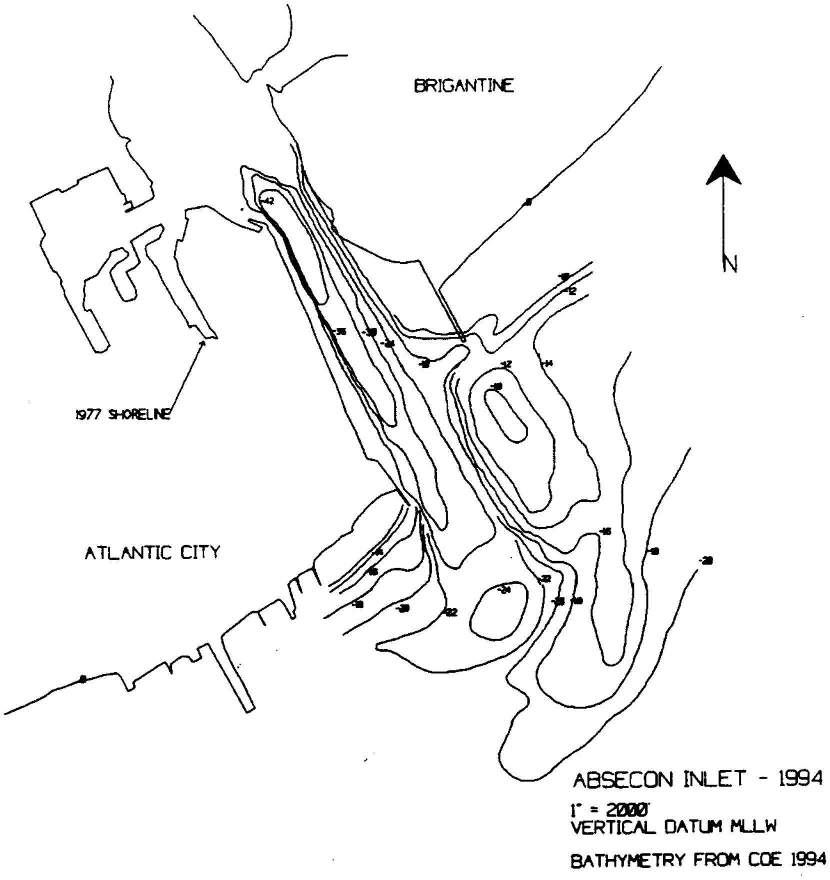


Figure 12

1994 Absecon Inlet Bathymetry

Table 14

ABSECON INLET: DREDGE HISTORY
from Annual Reports

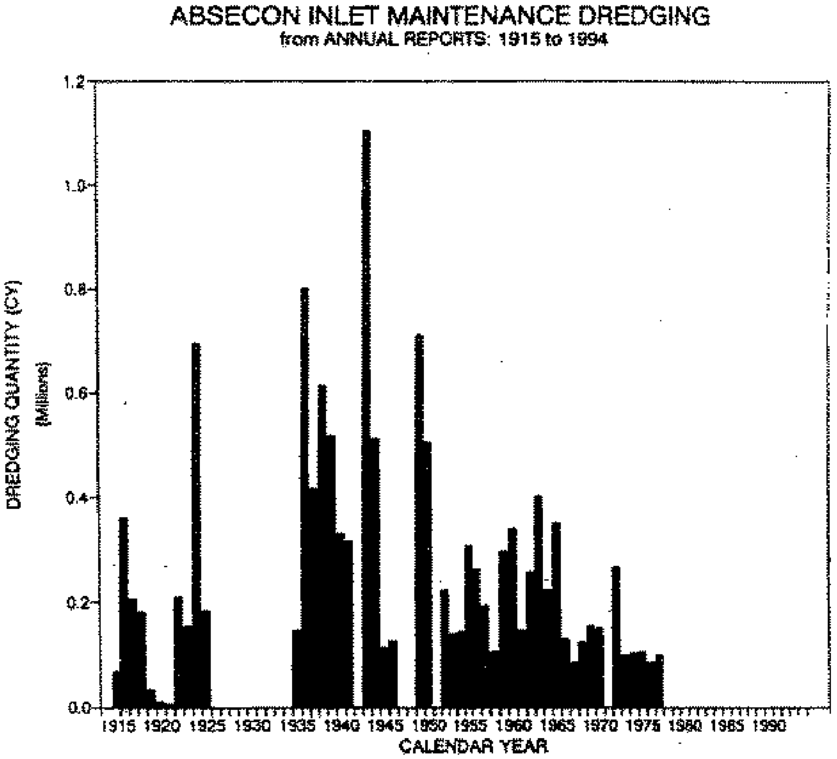
FISCAL	YEAR	INLET			CLAM CREEK	
(CY)		NEW WORK (CY)	MAINTENANCE DREDGING (CY)	CUMULATIVE (CY)	NEW WORK (CY)	MAINTENANCE DREDGING (CY)
Project Dimensions 12' by 300'	1915	68,350		68,350		
	1916		356,961	425,311		
	1917		205,960	631,271		
	1918		180,970	812,241	15,350	
	1919		32,320	844,561		
	1920		9,300	853,861		
	1921		5,840	859,701		
	1922		209,649	1,069,350		
	1923		152,727	1,222,077		
	1924	692,866		1,914,943		
	1925	183,310		2,098,253		
	1926		0	2,098,253		
Project Dimensions 20' by 400'	1927		0	2,098,253		
	1928		0	2,098,253		
	1929		0	2,098,253		
	1930		0	2,098,253		
	1931		0	2,098,253		
	1932		0	2,098,253		
	1933		0	2,098,253		
	1934		0	2,098,253		
	1935		145,122	2,243,375		
	1936		800,567	3,043,942		
	1937		414,533	3,458,475		
	1938		612,877	4,071,352		
	1939		516,197	4,587,549		
	1940		328,956	4,916,505		
	1941		313,658	5,230,163		
	1942		0	5,230,163		
	1943		1,103,766	6,333,929		

Table 14 Continued

FISCAL YEAR	INLET			CLAM CREEK	
	NEW WORK	MAINTENANCE DREDGING	CUMULATIVE	NEW WORK	MAINTENANCE DREDGING
1944		512,110	6,957,879		
1945		111,840	6,846,039		
1946		123,896	7,081,775		
1947		?	7,081,775		
1948		?	7,081,775		
1949		709,479	7,791,254		
1950		503,560	8,294,814		
1951		0	8,294,814		
1952		221,725	8,516,539		
1953		138,621	8,655,160		
1954		143,251	8,798,411		
1955		306,193	9,10,4604		
1956		281,817	9,386,421		
1957		193,470	9,559,891	126,865	
1958		103,489	9,683,380		
1959		296,475	9,959,855		
1960		339,706	10,299,561		
1961		144,716	10,444,277		
1962		256,507	10,700,784		
1963		401,345	11,102,129		13,161
1964		222,522	11,324,651		
1965		348,961	11,673,612		
1966		129,502	11,803,114		
1967		83,552	11,886,666		
1968		122,796	12,009,462		
1969		153,070	12,162,532		
1970		148,502	12,311,034		14,138
1971		0	12,311,034		
1972		265,264	12,576,298		
1973		97,265	12,673,563		
1974		102,154	12,775,717		
1975		104,077	12,879,794		
1976		83,470	12,963,264		
1977		96,990	13,060,254		17,150
1978		0	13,060,254		

Table 14 Continued

FISCAL YEAR	INLET			CLAM CREEK	
	NEW WORK	MAINTENANCE DREDGING	CUMULATIVE	NEW WORK	MAINTENANCE DREDGING
1979		0	13,080,254		
1980		0	13,080,254		
1981		0	13,080,254		
1982		0	13,080,254		
1983		0	13,080,254		
1984		0	13,080,254		34,000
1985		0	13,080,254		
1986		0	13,080,254		
1987		0	13,080,254		
1988		0	13,080,254		
1989		0	13,080,254		
1990		0	13,080,254		
1991		0	13,080,254		
1992		0	13,080,254		
1993		0	13,080,254		
1994		0	13,080,254		


ABSECON INLET MAINTENANCE DREDGING
from ANNUAL REPORTS: 1915 to 1994
DREDGING QUANTITY (CY)
(Millions)
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1915
1920
1925
1930
1935
1940
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
CALENDAR YEAR

194. Beach Fills. A summary of beach nourishment projects conducted from 1940 to 1994 on Absecon Island is provided in Table 15. The volume of material for each fill is considered a source or credit of material to the sediment budget analysis. The location of the borrow area for the respective fills must be examined and considered in the sediment budget computations.

Table 15
Summary of Beach Fill Projects on Absecon Island

Date Completed	Location of Fill	Quantity (cu yd)	Agency
1935-1943	Atlantic City (offshore berm)	3,554,000	USACE
1948	Atlantic City	1,073,000	USACE
March 1948	Atlantic City (Caspian to Oriental)	483,000	NJDEP
1963	Atlantic City (Oriental to Virginia)	560,000	NJDEP
1966	Atlantic City	125,000	USACE
July 1970	Atlantic City (Oriental to Illinois)	830,000	NJDEP
1978	Atlantic City (Illinois to Tennessee)		NJDEP
1979	Atlantic City	48,160	USACE
June 1983	Atlantic City (Massachusetts to Vermont)	43,000	NJDEP
June 1983	Atlantic City (Michigan to St. James)	32,000	NJDEP
June 1986	Atlantic City (Oriental to Arkansas)	1,000,000	NJDEP
1990	Longport	250,000	NJDEP

195. Coastal Structures. Coastal structures such as groins and jetties can have an effect on the sediment budget by trapping a portion of the littoral drift. Other structures present on Absecon Island, such as piers and outfalls, may have small effects on longshore transport processes depending on the density of their substructure. The terminal groin at Longport has had a significant effect on the southern portion of Absecon Island. The groin functions as a sediment

trap for material which otherwise would have been lost to the Great Egg Harbor Inlet complex.

196. SEDIMENT BUDGET ANALYSIS PROCEDURES. The following paragraphs describe the development of the sediment budget for Brigantine Inlet to Great Egg Harbor Inlet. The detailed sediment budget is provided in Appendix A.

197. The selection of the specific time periods for analysis was dependent on the availability of shoreline position data and wave data for the study area during the general period of interest between 1950-1993. Review of the available data indicated that shoreline position data for 1952, 1977 and 1986 were available from a database developed by Dr. Steve Leatherman of the University of Maryland Laboratory for Coastal Research. In addition, shoreline position data for 1993 based on digital orthophoto mapping of significant segments of the study area shoreline were also available.

198. Available wave data for the study area included Wave Information Study (WIS) hindcasts for the period 1956-1975 calculated at 3 hour intervals. In addition, wave hindcasts for the period 1987-1993 developed by Offshore & Coastal Technologies, Inc. (OCTI) for the Philadelphia District at 3 hour intervals near the WIS station were available..

199. Based on the availability of shoreline position and wave data, the specific periods of analysis for the sediment budget were selected to include:

1952-1977
1977-1986
1986-1993

Seven control volumes for the sediment budget analysis were selected. The first control volume is Little Beach, which is located at the northern end of the study area, extending from Little Egg Inlet south for 2.7 miles to Brigantine Inlet. This control volume provides the source of longshore sand transport into Brigantine Inlet from the north which results in potential inlet shoaling and potential sand bypassing to the Brigantine Island shoreline. An assumption is made that there is negligible sand bypassing from Brigantine Inlet across the southern boundary into this control volume.

200. The second control volume is Brigantine Inlet. Potential significant sand inputs to this control volume are assumed to be southerly sand transport from the north and northerly sand transport from the Brigantine Island shoreline. Potential sand outputs from this control volume are dredging, shoal growth, sand bypassing to the Brigantine oceanfront shoreline, and offshore losses.

201. The third control volume, Brigantine Island, extends from Brigantine Inlet south for 6.3 miles to the stone jetty at the southern end of Brigantine at Absecon Inlet. Potential sand inputs to this control volume are sand bypassing from Brigantine Inlet, shoreline erosion, and beach fills. Potential sand outputs from this control volume are northerly longshore sand transport across the

northern boundary into Brigantine Inlet, southerly longshore transport across the southern boundary into Absecon Inlet, offshore losses, and shoreline accretion. Significant events in this control volume include a 393,000 cubic yard beach fill in 1962, a 175,000 cubic yard beach fill in 1963, a 66,000 cubic yard beach fill in 1966, and jetty construction and extensions in 1952, 1959, and 1974.

202. The fourth control volume, Absecon Inlet, extends from the southern boundary of the Brigantine Island control volume south to a southern boundary at the stone jetty in Atlantic City. Potential sand inputs to this control volume are southerly longshore transport across its northern boundary from Brigantine Island and northerly longshore transport across the southerly boundary from Atlantic City. Potential sand outputs are dredging, sand bypassing to Atlantic City, shoal growth, and offshore losses. The most significant events in this control volume are the annual dredgings between 1952-1972 and the 1,000,000 cubic yard dredging for beach fill in 1986.

203. The fifth control volume, Absecon Island, extends from the northern boundary at Absecon Inlet south 8.0 miles to a southern boundary at the jetty at the southern end of Longport at Great Egg Harbor Inlet. Potential sand inputs to this control volume are sand bypassing across Absecon Inlet, shoreline erosion loss and beach fills. It is assumed that there is negligible sand bypass into this area from the Ocean City shoreline. Potential sand outputs include northerly longshore transport across the northern boundary into Absecon Inlet, southerly longshore transport across the southern boundary into Great Egg Harbor Inlet, shoreline accretion, and offshore losses.

204. The sixth control volume, Great Egg Harbor Inlet, extends from the southern boundary of the Absecon Island control volume to the northern end of Ocean City. Potential significant sand inputs to this control volume are assumed to be southerly sand transport from the Absecon Island area and northerly sand transport from the Ocean City shoreline. Potential sand outputs from this control volume are dredging, shoal growth, sand bypassing to the Ocean City oceanfront shoreline, and offshore losses.

205. The seventh control volume, Ocean City, extends from the northern boundary at Great Egg Harbor Inlet south 1.0 mile along the Ocean City shoreline. Potential sand inputs to this control volume are sand bypassing across Great Egg Harbor Inlet, shoreline erosion and beach fills. Potential sand outputs include northerly longshore transport across the northern boundary into Great Egg Harbor Inlet, southerly longshore transport across the southern boundary, shoreline accretion, and offshore losses.

206. One of the important components of the sediment budget analysis is the determination of the potential longshore sand transport which is an estimate of the maximum capacity of the breaking waves to carry sand alongshore in the presence of an unlimited supply of movable material. For this analysis, the GENESIS shoreline change model was used to develop the potential longshore sand transport rates along the study area shoreline. Local variations in longshore transport due to shoreline orientation changes were accounted for by applying the modeling using 215 ft. alongshore grid spacings for each of the four control volumes subject to longshore sand transport, Pullen Island, Brigantine Island, Absecon Island, and Ocean City. Hindcast wave data at 3 hour

intervals from 1987-1993 and the internal wave transformation routine in GENESIS were used to develop the potential longshore transport rates along each of the control volume shorelines. The longshore transport rates were averaged for the 6 year period for use in the sediment budget analysis. This procedure provided the average potential longshore sand transport rate to the left and to the right at each of the boundaries of the control volumes.

207. Volumetric shoreline changes were developed for each of the control volumes for each analysis period using historical shoreline change maps. Shoreline changes were converted to volumetric changes using a volumetric equivalent factor which assumes that the entire active profile moves at the same rate as the shoreline. For the purposes of this analysis, it was assumed that one foot of shoreline movement was equivalent to 1.0 cu yd/l ft of shoreline. Overall volumetric changes in each control volume were developed by determining the change in area between the respective shorelines at the 215 ft interval grid cells used in the GENESIS model for longshore sand transport calculations. The area changes were then converted to volume changes using the volumetric equivalent factor.

INLET PROCESSES AT ABSECON INLET

208. A history of general inlet geometry change for Absecon Inlet is available in "A Summary Document for the Use and Interpretation of the Historical Inlet Bathymetry Change Maps for the State of New Jersey," (Farrell, et. al., 1989). This section describes the findings of historical inlet shoreline change maps from the mid 1800s to the 1980s.

209. HISTORICAL PROCESSES. In addition to the inlet shoreline change descriptions discussed in Farrell, et. al. (1989), there is also an extensive discussion of pre-jetty inlet processes and shoreline erosion and deposition in Fitzgerald (1981). The processes described in this report have changed considerably due to the construction of the jetty and extensive dredging of the inlet for navigation, however valid historical information is provided.

210. In general, pre-jetty inlet processes are typical of most inlets on the southern coast of New Jersey (Figure 14). Longshore transport is to the south, with a seaward offset of the southerly barrier island. Sediment is deposited into the inlet tidal channel and updrift ebb tidal shoal by longshore transport. Sediment deposited in the tidal channel is carried seaward by ebb tidal currents and dispersed over the ebb tidal shoal. A portion of this material is then carried back into the channel by wave action. This deposition into the channel from the updrift side causes the channel to migrate to the downdrift, or southerly, side of the inlet, causing erosion along the southerly inlet facing shoreline. As the ebb tide shoal migrates to the south under the influence of waves and tidal currents, the seaward end of the main tidal channel bends around the northern end of the southerly barrier island, depositing large quantities of sediment seaward of the ocean facing beach. This deposition helps form and maintain the seaward offset of the downdrift island, by providing protection from storm waves and providing a source of sand which migrates landward, causing accretion on the ocean facing beach.

211. Accretion of material in the outer ebb shoal eventually causes the inlet channel to become hydraulically inefficient and a new channel is cut through the shoal more directly to the ocean. As the old channel fills in, the ebb shoal on the landward side of the new channel migrates landward and causes a temporary accretion along the northern end of the southerly barrier island. The southerly channel-facing beach also accretes due to movement of the channel away from the shoreline. As ebb currents deposit material at the seaward end of the new channel location, sediment seaward of the northern end of the southerly barrier island dissipates and moves shoreward at a reduced rate. The shoal which protected the end of the island begins to be reduced in elevation. Both onshore sediment supply is reduced and wave attack is increased leading to shoreline erosion in this location.

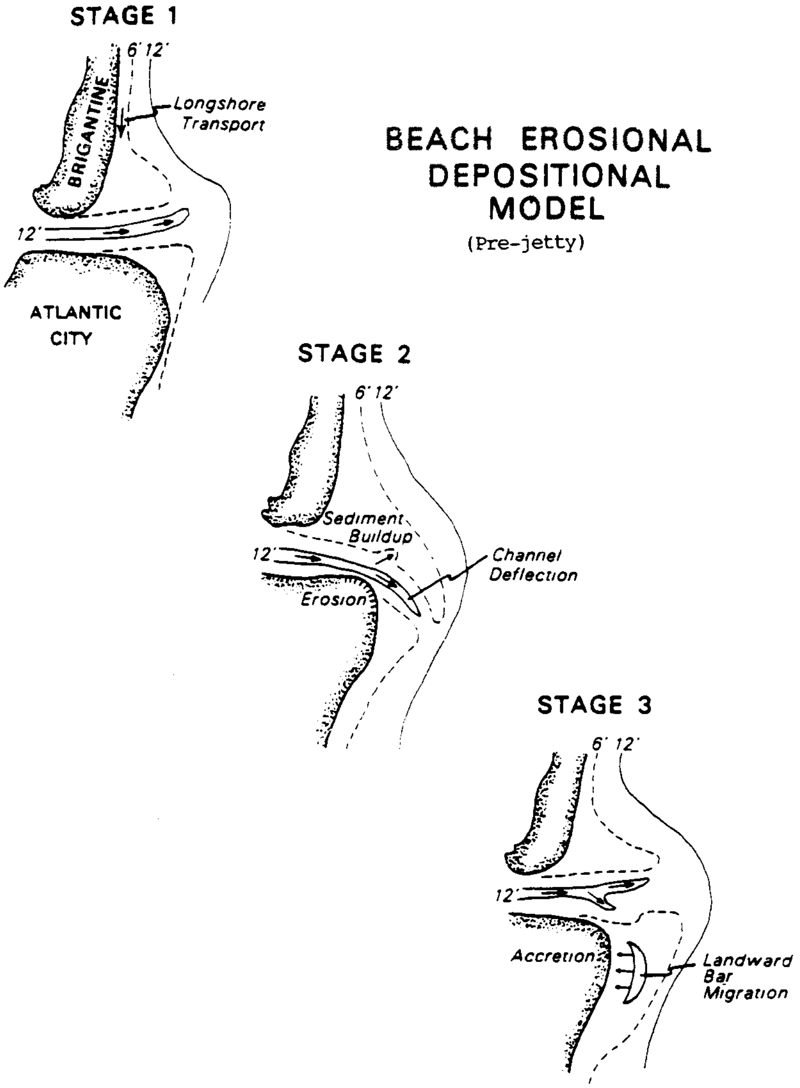

STAGE 1
6' 12'
BRIGANTINE
Longshore Transport
12'
ATLANTIC CITY
BEACH EROSIONAL DEPOSITIONAL MODEL
(Pre-jetty)
STAGE 2
6' 12'
Sediment Buildup
12'
Channel Deflection
Erosion
STAGE 3
6' 12'
12'
Accretion
Landward Bar Migration

Figure 14

212. Concurrently, continued updrift channel infilling causes the new channel to migrate to the south, repeating the cycle. The periodicity of the channel migration and breakthrough cycle depends on the distance the channel moves, and the amount of material which must be eroded and redeposited each cycle. Fitzgerald (1981) estimates that historically (pre-jetty) Absecon Inlet had a 10 to 20 year cycle of channel movement. This is similar to Townsends Inlet, where the seaward end of the channel breaks through the ebb shoal in a more northerly channel and then migrates to the south on a frequent basis. Hereford Inlet, on the other hand, has a very long period natural channel migration and island erosion/deposition cycle of approximately 60 years, because of the much greater width of the inlet and the greater migration distance of the channel.

213. PRESENT DAY PROCESSES. Since dredging began at Absecon Inlet in 1915, and especially since the jetty construction in the mid 1950s, the channel has remained relatively stable. A deep channel extends seaward from the mouth of the inlet defined by the Brigantine Jetty on the north and the inlet shoreline and the Oriental Street Jetty on the south. Dredging has, in the past, maintained a channel alignment extending straight out from the inlet mouth. Since maintenance dredging was discontinued in 1977, the channel has migrated somewhat to the south due to the intrusion of the updrift ebb tidal shoal.

214. Present day inlet sedimentation processes are as follows. A schematic diagram of the predominant sediment pathways is shown in Figure 15. Net longshore transport carries material from the north until it reaches the Brigantine Jetty. A portion of the material is carried past the jetty either by flow over the jetty, infiltration through the jetty, or by wind, and is deposited into the interior shoals adjacent to the jetty on the north side of the channel. From there the material is carried into the inlet by longshore transport to the north until it is intercepted by tidal currents and carried back seaward by ebb tide flows. Since the interior shoals appear to be in equilibrium, based on historical bathymetry, additional material is not presently being stored in the shoal, so that the quantity of material picked up by the tidal currents equals the amount of sediment passing the jetty. The remainder of the longshore transport passes around the end of the jetty, carried by wave action and flood tide currents, and is deposited in the tidal channel or outer ebb tide shoal. Material on the shoal is transported landward by wave action until it is deposited in the tidal channel. Material deposited in the tidal channel is carried seaward by the ebb tide current and dispersed over the seaward end of the channel.

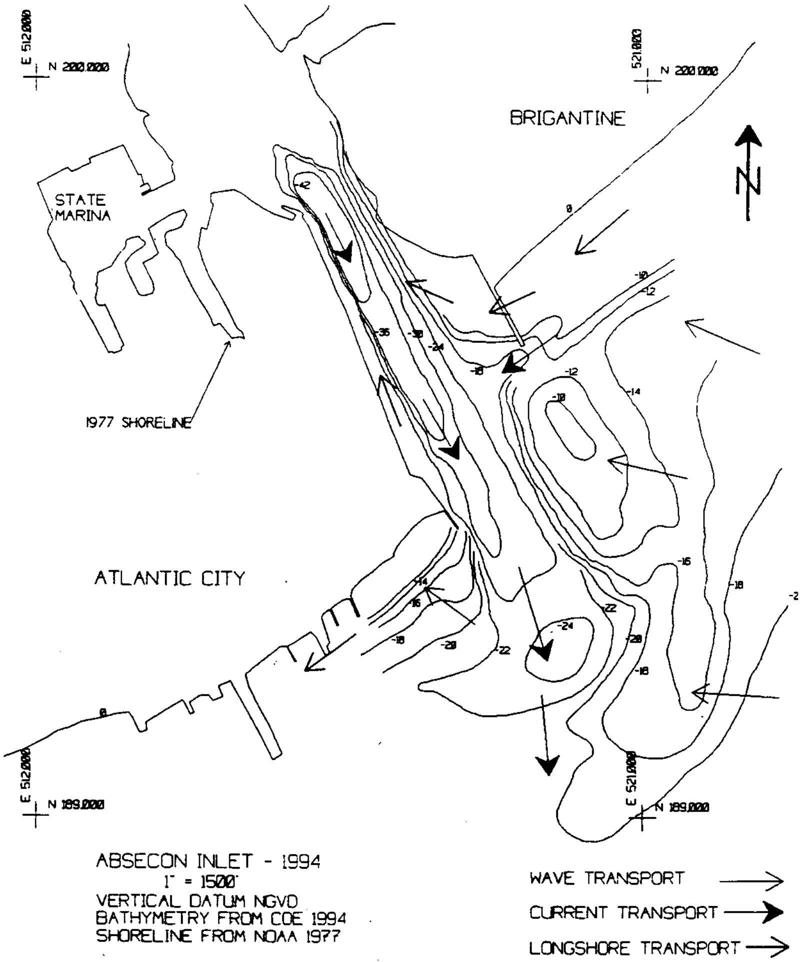


Figure 15 Sediment Pathways

215. Figures 16 through 19 show ebb and flood currents for a spring tide condition for both the 1994 and 1977 bathymetries. It can be seen that relatively strong currents exist to several thousand feet offshore. Due to extensive dredging in Absecon Inlet since 1915 (approximately 14 million cubic yards removed over 80 years), the ebb tidal shoals have been greatly depleted and the shoals are much deeper than typical southern New Jersey inlet shoals. However, a portion of the sediment carried seaward by the tidal currents is deposited in relatively shallow depths seaward of the Atlantic City beaches, where it is carried landward onto the beach by wave action.

216. The remainder of the material which is carried seaward by the ebb currents is spread out over the sea floor over a large area. Due to the large tidal currents and lack of ebb tidal shoals, the material appears to be carried further seaward than at other southern New Jersey Inlets. Based on the sediment budget and the existence of extensive linear shoals seaward and north of Absecon Inlet, it is believed that significant quantities of sand are transported offshore and lost to the nearshore system.

217. Figure 20 shows the net wave sediment transport potential at Absecon Inlet. It can be seen that the wave transport is to the west, and is strongest over the shallow shoals and nearshore contours. The onshore wave transport is responsible for the formation of the shoal defined by the -10 foot contour seaward of the Brigantine Jetty, as well as the deeper shoals seaward of the end of the ebb tidal channel. The waves tend to return sand landward which has been carried offshore by the ebb currents. However, as noted above, it appears likely that the wave transport is not sufficiently strong over the dredged shoal area to return all of the material back to shore, resulting in a loss of material from the inlet shoal area. Figure 21 further shows wave sedimentation patterns, as defined by the gradient in the wave transport potential. Again it can be seen that the areas of strongest potential sediment movement is in the shallow water areas.

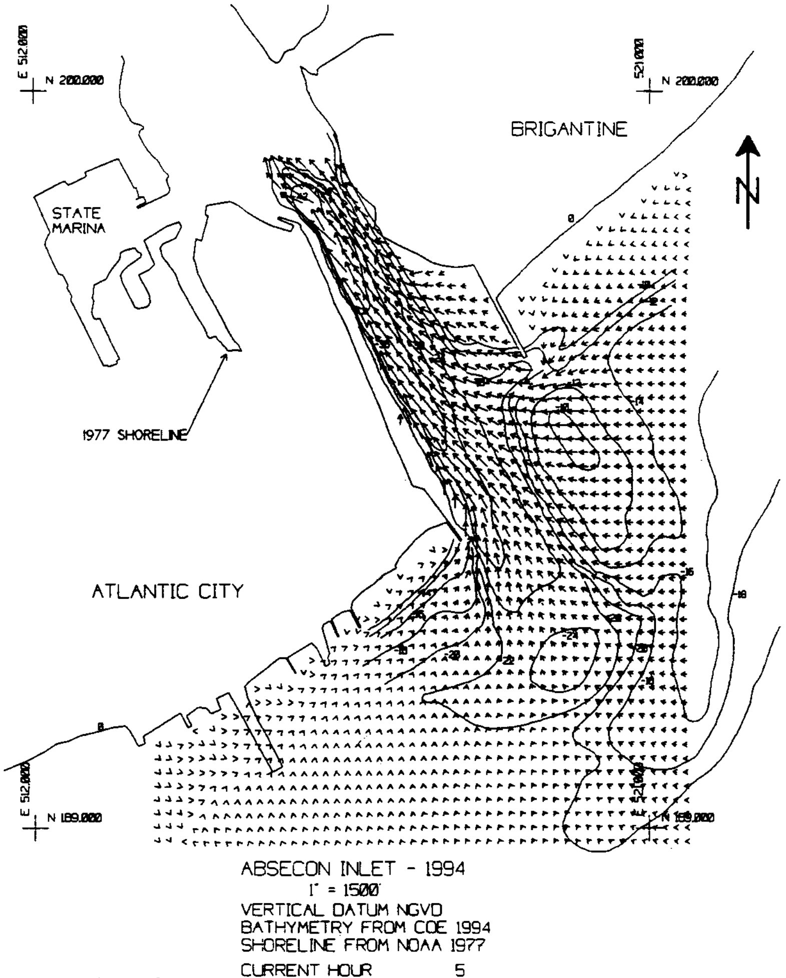


Figure 16 Absecon Inlet Current Field, Flood Tide, 1994

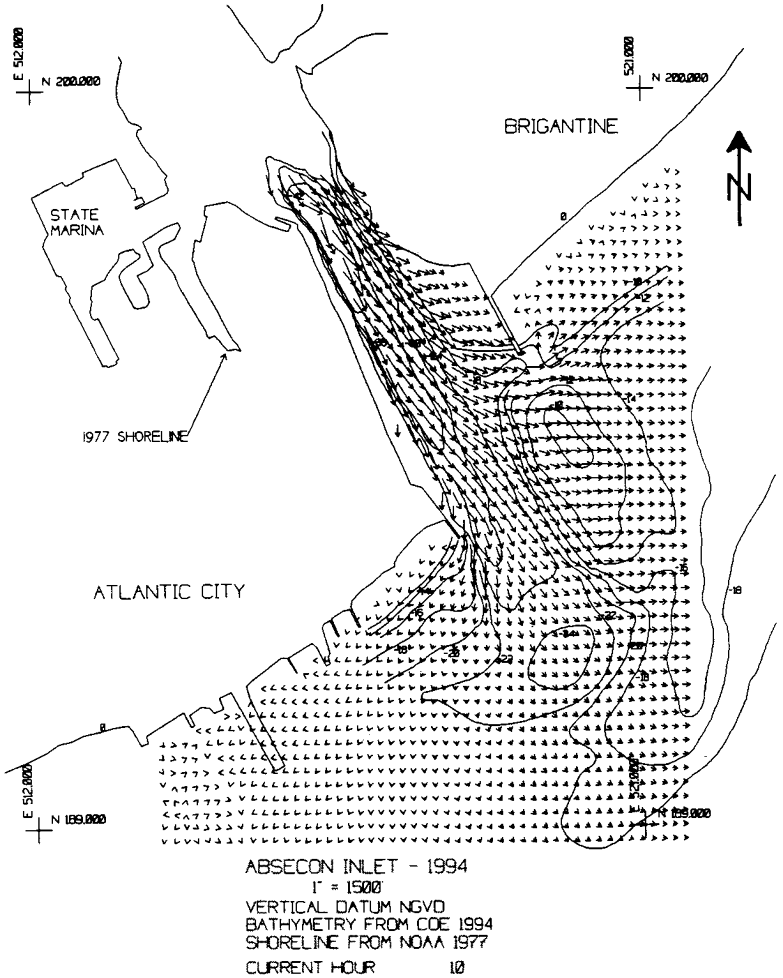


Figure 17 Absecon Inlet Current Field, Ebb Tide, 1994

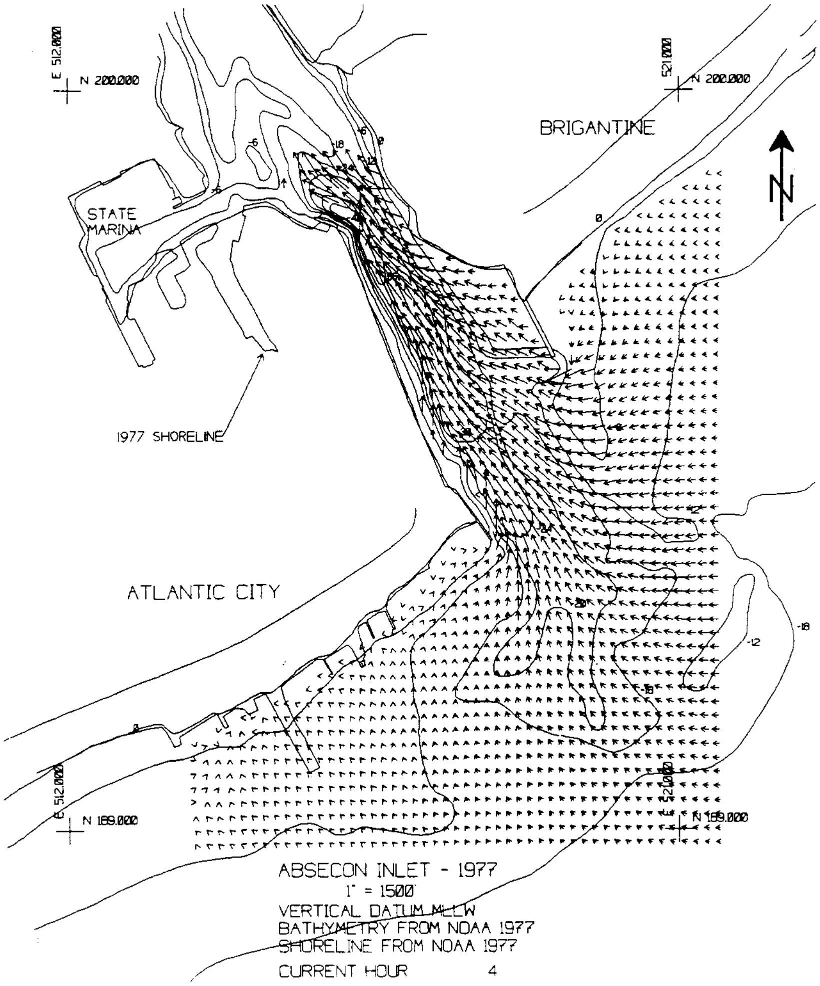


Figure 18 Absecon Inlet Current Field, Flood Tide, 1977

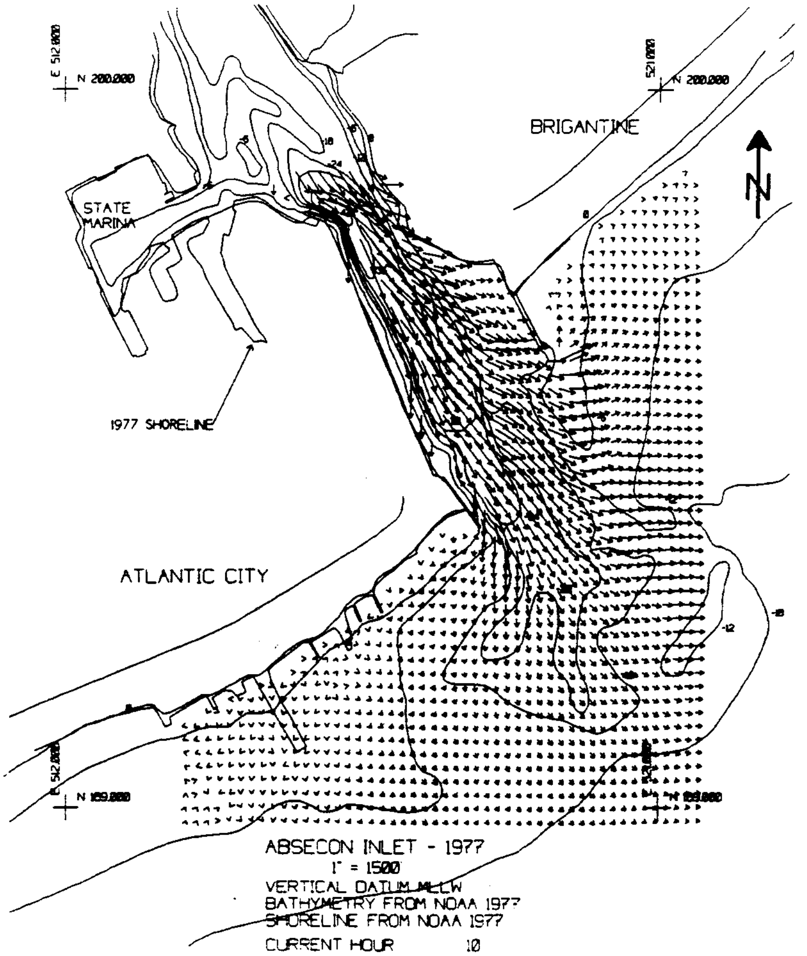


Figure 19 Absecon Inlet Current Field, Ebb Tide, 1977

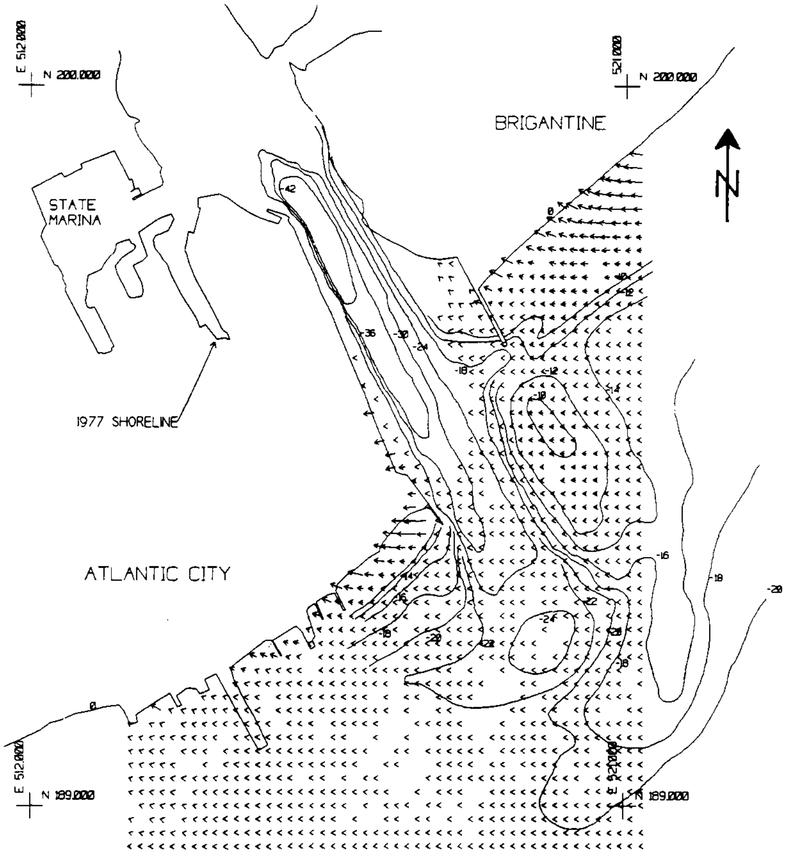


Figure 20

ABSECON INLET - 1994
1" = 1500'
VERTICAL DATUM NGVD
BATHYMETRY FROM COE 1994
SHORELINE FROM NOAA 1977

WAVE TRANSPORT POTENTIAL
VECTORS

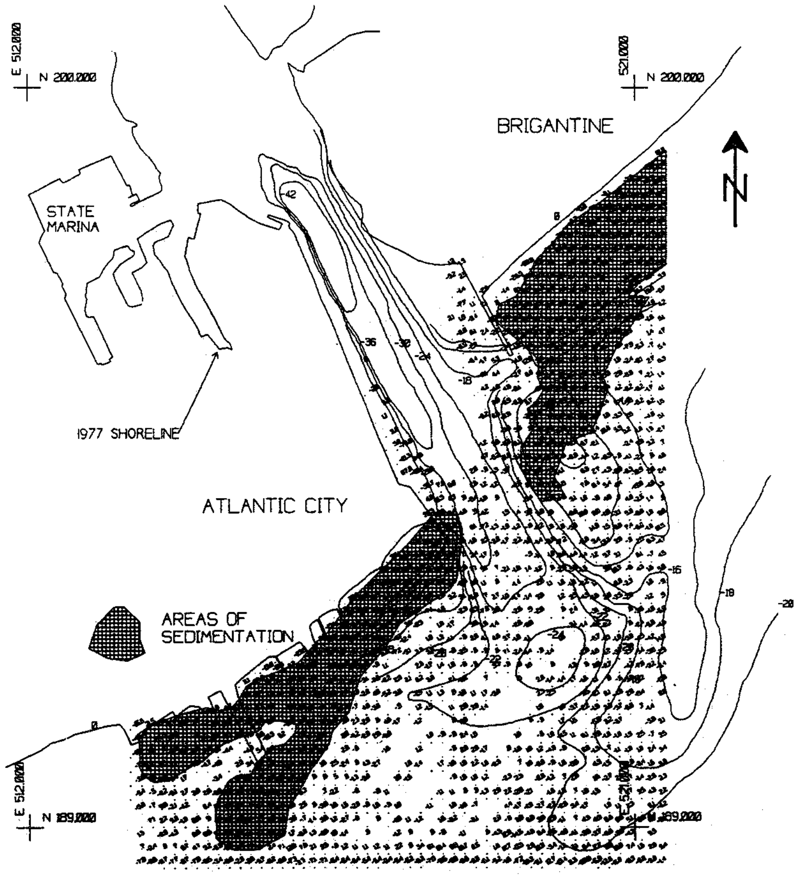


Figure 21

ABSECON INLET - 1994
1" = 1500'
VERTICAL DATUM NGVD
BATHYMETRY FROM COE 1994
SHORELINE FROM NOAA 1977

WAVE SEDIMENTATION
PATTERNS

218. FUTURE CONDITIONS. Based on the assumption that at the present time a significant portion of the longshore transport entering Absecon Inlet from the north is being lost offshore due to high ebb tidal currents, as opposed to bypassing the inlet to the southern shoreline or being stored in inlet shoals, future conditions in the inlet can be projected. Without future dredging for navigation or beach fill borrow, it is likely that the deep shoals to the north of the existing channel will grow over time, and continue to wrap around the channel and deflect the main ebb channel to the south. This is based on results of the wave modeling and analysis of historical patterns of sedimentation in Absecon Inlet and other southern New Jersey Inlets. However, due to the continuing loss of material offshore, this buildup of the ebb tidal shoals will be slow. It is anticipated that without dredging, over the span of the next 20 years the ebb tidal shoals will begin to increase sufficiently to reduce inlet flows and ebb tidal current velocities. As ebb currents are reduced in velocity and deflected further southward, less material will be lost offshore and the rate of buildup of the shoals will increase.

219. Therefore, without future dredging, Absecon Inlet could have significant ebb tidal shoals at the end of a 50-year project period. The larger ebb shoal would provide additional protection from waves for the nearshore areas, and increase natural bypassing to the Absecon Island shoreline. In time, the inlet would re-establish its original sediment processes, as described in the Historical Processes section. However, this would not occur until the end of the 50-year period or beyond.

220. Due to the importance of the inlet to local commercial and recreational navigation, it is unlikely that ebb tidal shoals will be allowed to accumulate sufficiently to block the navigation channel. If navigation dredging takes place, the ebb currents will continue to transport material offshore out of the inlet system. Additional dredging for beach nourishment will also tend to prevent the buildup of the ebb shoals, and will therefore maintain the present condition of minimal natural bypassing and loss of material offshore. Depending upon the rate of inlet dredging, the shoals may increase in volume in the future and provide a partial decrease in wave attack at the shoreline; however, this effect is expected to be minor if the inlet is maintained with a navigation channel with a depth greater than 20 feet.

SHORELINE CONDITIONS

221. HISTORIC SHORELINE CONDITIONS. A historic shoreline analysis of Absecon Island was conducted for the Atlantic Ocean and Absecon Inlet shorelines. This analysis documents past behavior and "background" conditions of the shoreline and determines long-term erosion rates where applicable in the study area. This rate can vary significantly depending on the time period analyzed.

222. Data Sources. The historic shoreline analysis relied on four principal types of information: aerial photography, onshore/offshore beach profiles, digital shoreline change maps, and previous reports. The aerial photography utilized for Absecon Island included the following dates: 1955, 1962, 1964, 1970, 1984, 1985, 1988, and 1993. Most of the aerial photography is vertical black-

and-white at a contact scale of 1 inch equals 400 feet. Ground-level photography was obtained in 1988 to provide a detailed documentation of shoreline conditions and protective structures.

223. Beach profiles in Atlantic City have been monitored by the Corps of Engineers in a variety of locations since 1936. Beginning in 1955, a series of a profile line locations was established along the entire ocean and inlet frontage of Absecon Island, including Atlantic City, Ventnor, Margate, and Longport. This series of profile lines was surveyed in 1955, 1962, 1965, 1988, 1993, and 1994. There are two historic profile lines on the Absecon Inlet frontage, six on the ocean shoreline of Atlantic City, three in Ventnor, four in Margate, and four in Longport. The profile lines typically extend from the landward crest of the beach profile (i.e., top of dune or, where present, top of bulkhead) seaward out to the 30 ft depth contour. In order to better document shoreline conditions for purposes of this feasibility study, the 1993 and 1994 beach surveys were expanded to include more survey lines across Absecon Island. Most of these additional transects replicate lines surveyed as part of the New Jersey State Beach Profile Network. A total of 22 profile lines were surveyed in August 1993, providing a typical "summer beach" condition and in March/April 1994, providing a typical "winter beach" condition. Figure 2 showed the locations of the various profile lines. Cross-sectional plots of the August 1993 profiles are provided in Appendix A.

224. Historic shorelines of Absecon Island were digitally mapped as part of the New Jersey Historical Shoreline Map Series (Farrell and Leatherman, 1989). These maps include shorelines from 1836-42, 1871-75, 1899, 1932-36, 1951-53, 1971, 1977, and 1986. The shoreline from 1993 was subsequently added as part the photogrammetry work done for this study. The shoreline represents mean high water as determined from the digital terrain map. The shoreline maps provide a beneficial overview of shoreline conditions through time. However, it is difficult to evaluate and differentiate natural shoreline evolution from the effects of development and coastal protection projects (such as beach fills and coastal structures). The numerous beach fills placed on the northern end of Atlantic City since 1948 must be accounted for when evaluating shoreline behavior from these maps.

225. Reports pertinent to Absecon Island were compiled and reviewed for this analysis. This information was used to develop a qualitative, and where possible, quantitative understanding of historic behavior of the Absecon Island ocean and inlet shorelines. These reports include:

> House Document 81-538, "Atlantic City Beach Erosion Control Study", 1950;
>
> House Document 86-208, "Shore of New Jersey - Barnegat Inlet to Cape May Canal, Beach Erosion Control Study", 1959;
>
> House Document 88-298, "Atlantic City, New Jersey: Interim Hurricane Survey", 1964;
>
> House Document 88-325, "Atlantic City, New Jersey, Beach Erosion Control Study", 1964;

House Document 94-631, "New Jersey Coastal Inlets and Beaches - Barnegat Inlet to Longport", 1976;

New Jersey Shore Protection Master Plan", Dames and Moore, for NJDEP, 1981;

"Coastal Geomorphology of New Jersey", Karl F. Nordstrom, Rutgers Center for Coastal and Environmental Studies, 1977;

"Behavior of Beach Fill at Atlantic City, New Jersey", Everts et al., U.S. Army Engineer Coastal Engineering Research Center, CERC Reprint 12-74, 1974;

"Beach Changes Caused by the Atlantic Coast Storm of 17 December 1970", DeWall, et al., U.S. Army Engineer Coastal Engineering Research Center, Technical Paper 77-1, 1977;

"Beach Changes at Atlantic City, New Jersey (1962-73)", Dennis P. McCann, U.S. Army Engineer Coastal Engineering Research Center, Miscellaneous Report 81-3, 1981;

"Evaluation of Beach Behavior and Coastal Structure Effects at Atlantic City, NJ," Robert M. Sorensen and J. Richard Weggel, for NJDEP, 1985;

"Monitoring and Evaluation of 1986 Beach Nourishment, Atlantic City, New Jersey," Robert M. Sorensen, J. Richard Weggel, and Scott M. Douglass, for NJDEP, 1989.

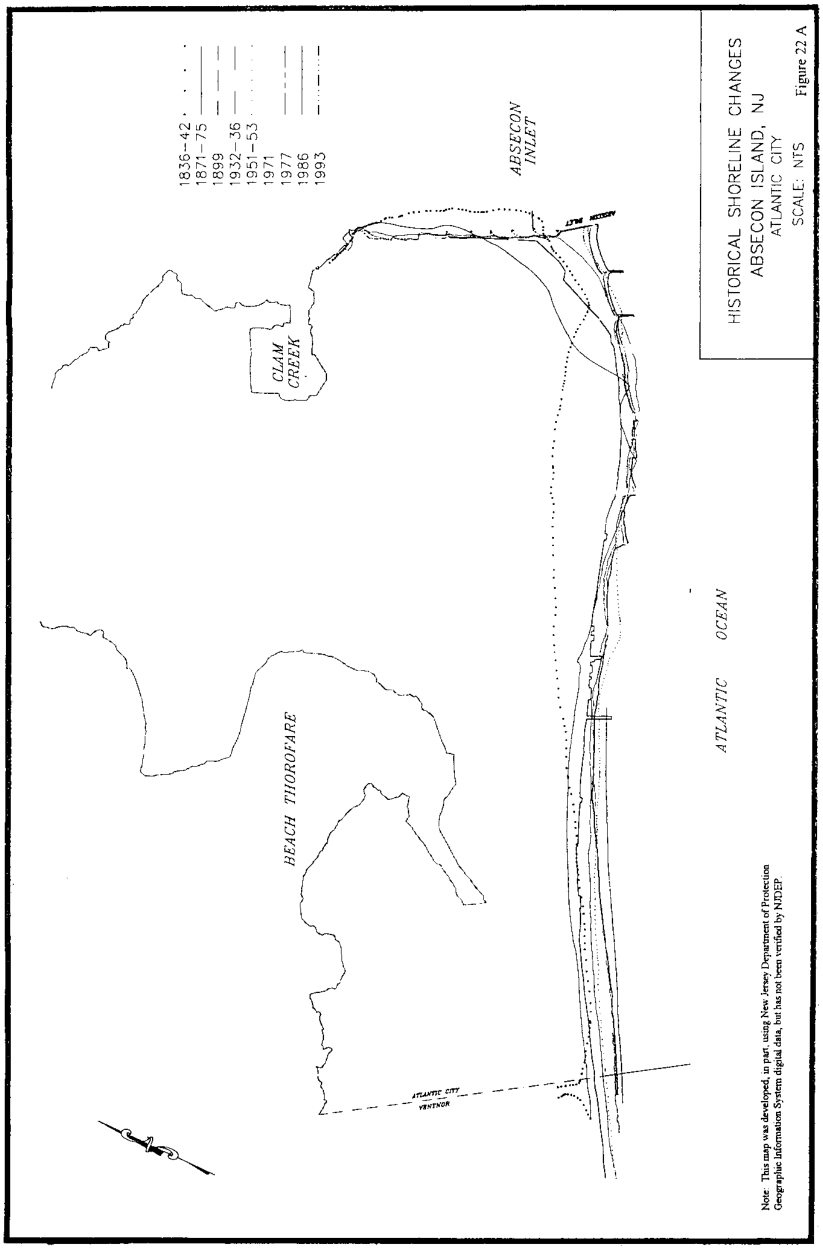
"New Jersey Beach Profile Network Analysis of the Shoreline for Reaches 1-15, Raritan Bay to Stow Creek," Stewart C. Farrell et al., for NJDEP, 1993.

226. Summary of Historical Shoreline Conditions. Figure 22 provides an overview of shorelines through time from Absecon Inlet to Great Egg Harbor Inlet and vicinity, including Atlantic City, Ventnor, Margate and Longport. Historically, the most dynamic section of shoreline is located approximately two miles south of Absecon Inlet. This reach experienced significant landward-seaward oscillations prior to construction of shore stabilization structures (primarily in the 1930's and 1940's). For example, between 1842 and 1877 shoreline movements as large as 1500 ft have occurred (McCann 1981). Construction of groins and the Oriental Avenue jetty have greatly reduced such extreme shoreline fluctuations; however, the trend in this portion of Atlantic City over the past four decades has been progressive erosion countered by periodic beach nourishments (Sorensen, Weggel, and Douglass 1989).

227. The Atlantic City shoreline along Absecon Inlet progressively receded from 1836 to 1899. The inlet shoreline has essentially remained in a similar location from 1899 to 1993 (Figure 22A). Minimal beach exists in this area, and consists mostly of small fillets of material in the vicinity of the Maine Avenue groins. Channel locations relative to the inlet shoreline and natural inlet bypassing processes are further discussed in subsequent sections on the sediment budget for

Absecon Island and shoaling analysis for Absecon Inlet.

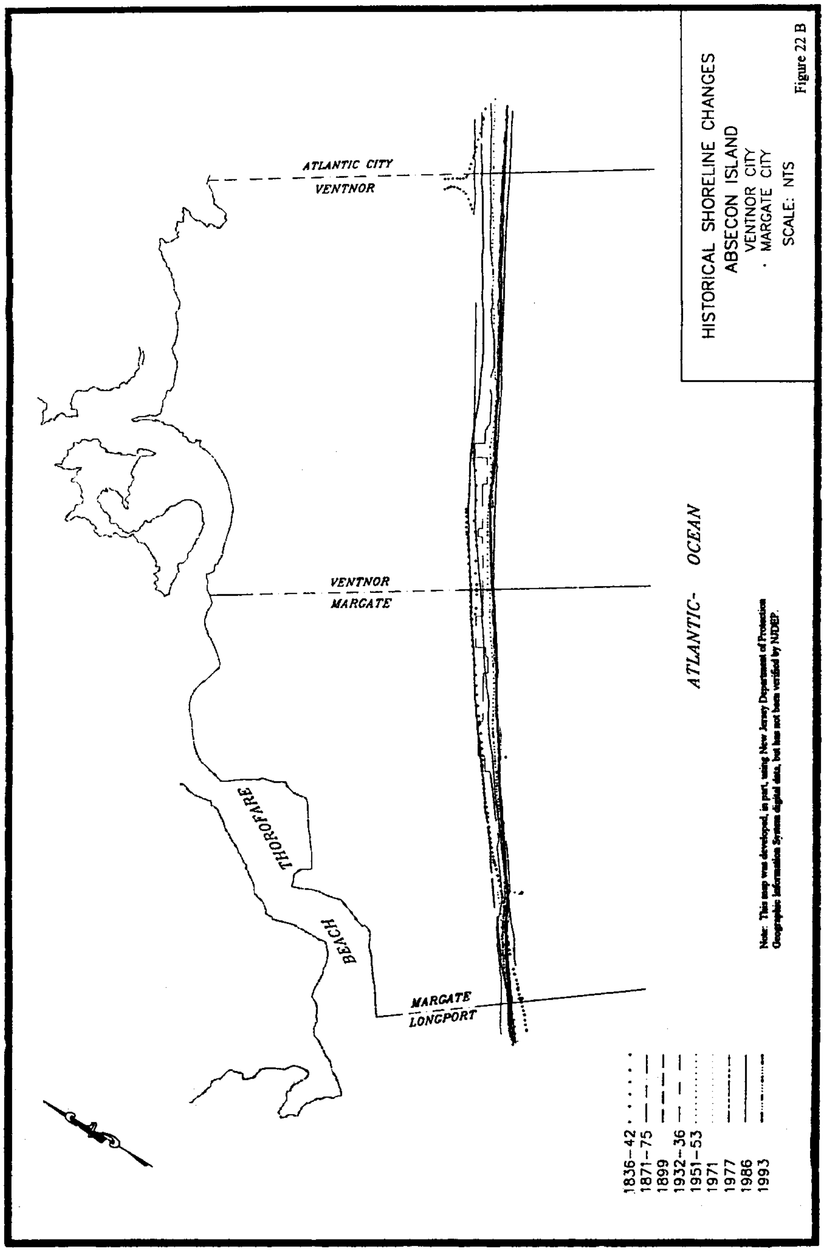
228. Historically, shoreline change along Ventnor, Margate, and Longport has not been evaluated to the same extent as shoreline behavior in Atlantic City. The numerous beach fills in Atlantic City have most likely contributed to the accretionary behavior of the downdrift shorelines along Absecon Island. Analysis of shoreline change maps shows that the Ventnor shoreline has generally been accretionary from 1836 to the present (Figure 22B). Although more variable through time, the overall trend along the Margate shoreline has been one of accretion. Beach width has historically been largest in northern Margate and decreases to the south.



HISTORICAL SHORELINE CHANGES
ABSECON ISLAND, NJ
ATLANTIC CITY
SCALE: NTS

Figure 22 A

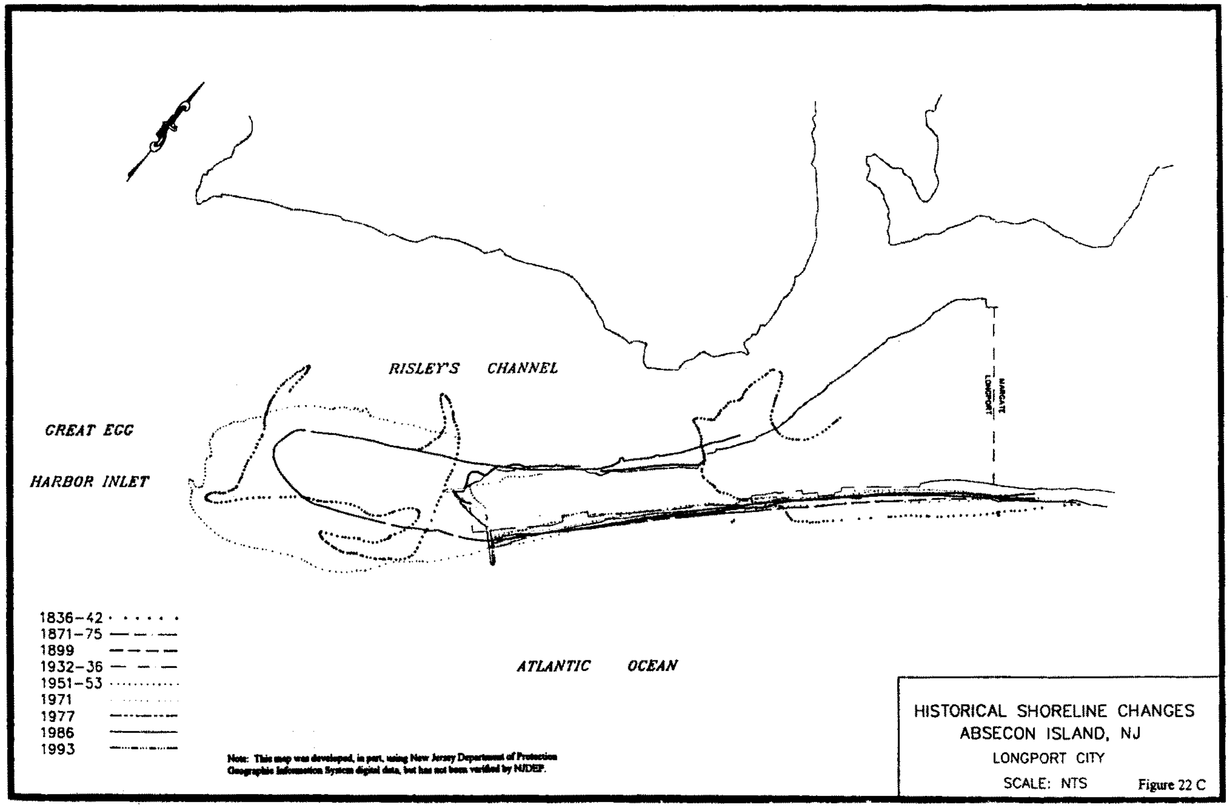
Note: This map was developed, in part, using New Jersey Department of Protection Geographic Information System digital data, but has not been verified by NJDEP.



HISTORICAL SHORELINE CHANGES
ABSECON ISLAND
VENTNOR CITY
MARGATE CITY
SCALE: NTS

Note: This map was developed, in part, using New Jersey Department of Protection Geographic Information System digital data, but has not been verified by NJDEP.

Figure 22 B



Note: This map was developed, in part, using New Jersey Department of Protection Geographic Information System digital data, but has not been verified by NJDEP.

HISTORICAL SHORELINE CHANGES
ABSECON ISLAND, NJ
LONGPORT CITY
SCALE: NTS

Figure 22 C

229. The shoreline along Longport has fluctuated through time, although it appears to be more stable since 1977 (Figure 22C). Construction of the terminal groin in 1953 helped to stabilize the large oscillations in shoreline immediately adjacent to Great Egg Harbor Inlet. Presently, the narrowest section of beach in Longport is located in the vicinity of 26th to 30th Ave.; however, it appears that this area has been historically narrow in beach width. A brief comparison of survey data from 1965 to 1993 for LRP 90 shows some erosion along the beach profile between July 1965 and November 1988 (although this may be accounted for by seasonal differences), and notable accretion from 1988 through 1993 (in addition to the 1990 beach fill material).

230. History of Beach Fills. The analysis of beach profile and aerial photographic data for Absecon Island is complicated by a number of activities, the most important being beachfill placement. Table 15 presented a history of beach fills for Absecon Island. Beach nourishments and other coastal construction activities have affected the otherwise normal evolution and response of the study area shorelines to natural physical factors such as waves and tidal currents. In order to estimate the probable "no-action" shoreline behavior, it is necessary to adjust the observed historic shoreline changes to account for the changes attributable to the beach fills.

231. EXISTING SHORELINE CONDITIONS. Various reaches along Absecon Island were evaluated to determine if the shoreline was stable, accreting, or eroding. Shoreline behavior was documented using aerial photography, beach profiles, shoreline change maps, and pertinent reports.

232. This analysis concluded that starting conditions for the base year of 2001 would best be represented by conditions documented in 1993 for the Absecon Inlet frontage of Atlantic City and for Ventnor Margate and Longport. Much of the Atlantic City oceanfront, however, which has required most of the beach nourishment placed since 1948, is considered likely to experience a progressive loss of beach width under the "no-action" scenario, although at an average long-term rate lower than that experienced immediately following previous placements. Table 16 reflects the average annual shoreline retreat rates which were adopted to reflect probable behavior of the Atlantic City ocean shoreline.

Table 16
Long Term Erosion Rates

Shoreline Locations	Erosion Rate (ft/yr)
Massachusetts to Pennsylvania Ave.	2.5
Pennsylvania to Martin Luther King Blvd.	2.5
Martin Luther King Blvd. to Arkansas Ave.	7.0
Arkansas to Brighton Ave.	7.0
Brighton to Albany Ave.	3.0

233. The remainder of Atlantic City, as well as Ventnor, Margate, and Longport, are projected to have no long-term erosion trend over the period of analysis for this study. Therefore, the conditions portrayed by the 1993 beach profiles were adopted to define "no-action" conditions for the beach recreation and storm erosion analyses.

234. Aerial photography and beach profile data from 1988, 1990 and 1993 were compared to determine if there have been significant changes in shoreline trends. The shoreline was examined primarily at each historical LRP profile line location. Given the natural short-term variability typical of beach profiles in this area, this analysis concluded that the rates provided in Table 16 are valid for the study area.

PROBLEM IDENTIFICATION

235. Water resource problems associated with the main study objectives are identified below. The problems which exist in the study area were identified during site visits, literature review, public and interagency coordination, surveys and aerial reconnaissance flights.

236. PROBLEM ANALYSIS. The problem categories are 1) shoreline erosion over the long term, 2) storm damage vulnerability with a high potential for storm-induced erosion, inundation and wave attack which is exacerbated by long term erosion and 3) shoreline stability along inlets.

237. The principal water resources problems identified along Absecon Island are progressive beach erosion due to long term shore processes, and the threat of storm damage. This reach of the New Jersey shoreline was one of the earliest to be developed. The Longport seawall was built in 1917 after the loss of the southernmost ten blocks of the community. Strides have been made in some areas to minimize losses associated with storm damage. Such advances include building code improvements, dune ordinances and building restrictions. Many portions of the developed coast will remain vulnerable however, due to the proximity of structures to the beach and the level of development.

238. LONG TERM SHORELINE EROSION. Progressive and constant erosion is evident in certain areas of the coastline. This erosion slowly narrows the protective beach width. Atlantic City's northern shoulder has long term erosion rates of between 2.5 and 7 feet per year.

239. It should be noted that simply because areas may have relatively stable or low background erosion rates does not preclude the need to fully address options for additional shore protection. Ventnor and Margate have relatively wide beaches in some areas but the dunes are small and discontinuous. Nor does a stable historic erosion rate mean that over the course of several years shoreline positions and elevations do not vary greatly. For example Longport, which has a relatively stable shoreline position due to its seawall, lost a great deal of beach elevation during the recent storms of 1991 and 1992. A lower beach elevation will allow larger waves to impact

the oceanfront. The beach elevation regained in subsequent years is presumably concurrent with a loss of sand in the northern beaches. Presently, much of the existing beachfront in Longport lacks an adequate dune system and the berm width is zero in front of the seawall.

240. FLOODING AND STORM DAMAGES. The principal source of economic damages identified along the Atlantic coast of New Jersey are storms. An accurate assessment of historic storm damages, delineated by causal mechanism, is difficult to develop for coastal storms. Along the study area, records of historic storm damages are poor except for the 1962 Northeaster, the coastal storm of 1984 and the December 1992 storm.

241. The years 1991-1992 brought three significant storms to the study area. A summary of historic storm damage information for the study area is presented in Table 17. Figures for some of the most recent storms have not been independently confirmed and do not necessarily represent the potential damages that could be prevented by a Federal shore protection project. Additionally, damages which qualify for post-storm FEMA assistance do not completely capture losses due to the storm.

TABLE 17

HISTORIC STORM DAMAGE DATA

DATE	DAMAGES	NOTES
9/1889	$50,000 (1889 $)	Heinz Pier, Atlantic City
10/1896	$33,000 (1896 $)	Atlantic City
9/38	$70,000 (1938 $)	Brigantine to Atlantic City
9/44	$5,000,000 (1944 $)	Atlantic City; 62% attributable to wave damage.
	$1,000,000 (1944 $)	Ventnor, Margate, Longport
11/50	$564,000 (1950 $)	Absecon Island
	$100,000 (1950 $)	Longport
3/62	$21,634,700 (1962 $)	Absecon Island; 10% attributable to wave action
3/84	$1,450,325 (1984 $)	Atlantic County
10/91	$13,000,000	Atlantic County (initial amount claimed by County)
1/92	$2,650,000	Absecon Island (NJDEP estimate to repair beaches only)
12/92	$1,183,854	Atlantic City
	$ 259,405	Ventnor
	$ 437,070	Margate
	$ 125,199	Longport
	$2,600,000	Atlantic County (FEMA qualified damages)

242. SHORELINE STABILITY ALONG INLETS. Shorelines in the vicinity of inlets are particularly difficult to predict yet their equilibrium is easy to disturb. Inlet channels which separate New Jersey's offset barrier islands typically hug the southern shoreline. Coupled with extensive development, these inlet frontages are subject to erosional pressure exerted by the location of the channel and waves entering the inlet from the northeast. Absecon Inlet frontage has been devoid of a beach since the stabilization of the inlet in the 1940's and 1950's.

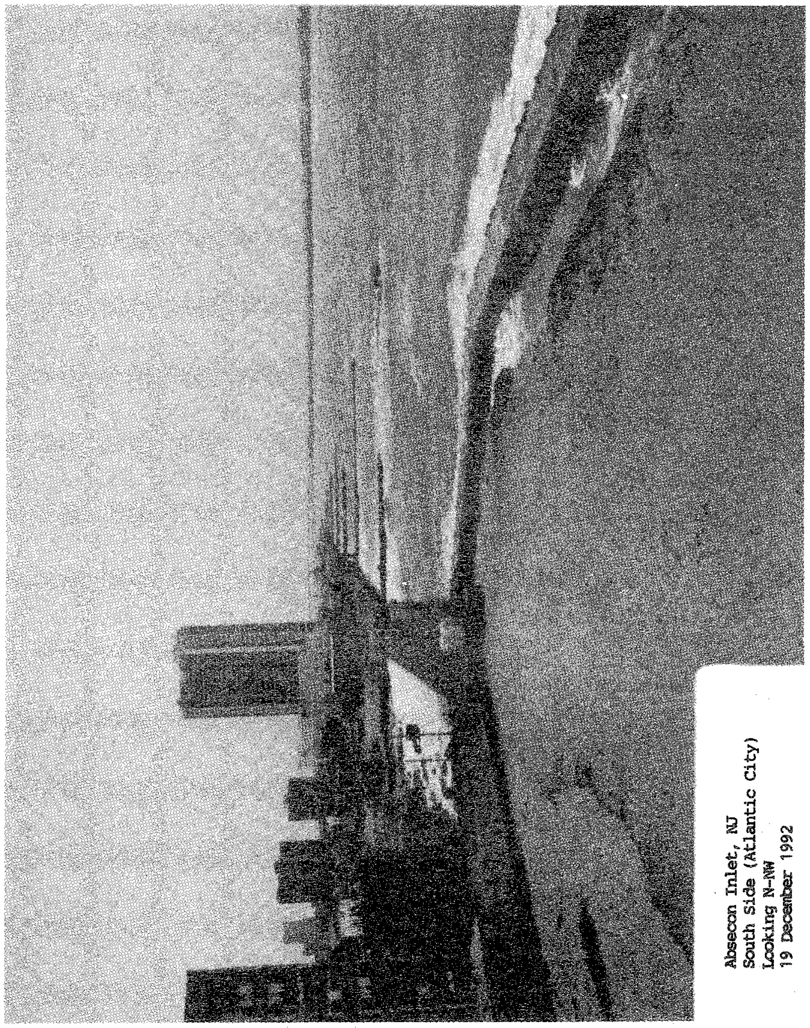
243. Local reversals in the littoral transport are dominated by the tidal influence at the inlet, and the extent and location of shoals. This can be seen at the northern shoulder of Atlantic City. An example of the emphemoral nature of sandy beaches at an inlet is the erosion of the fillet at the southern end of Longport. In 1993, the configuration reverted to a condition which existed in the

1970's. In response, NJDEP placed a rock revetment at the bulkhead to prevent continued rapid erosion. Shortly thereafter, the beach returned.

244. PROBLEM IDENTIFICATION BY AREA. The study area has been subdivided into two distinct areas. Problems specific to each area are listed as follows.

245. Absecon Inlet Frontage - Atlantic City. The northeast facing orientation of Atlantic City's inlet frontage increases its vulnerability to storm damage. Also adding to its exposure is the lack of protective beach. When the Maine Avenue groins were constructed in the 1930's and 1940's, the shoreline was stabilized although the beach disappeared (see figure 23). The Absecon Inlet Federal Navigation Project completed in 1957 located the channel in its present location which can be discerned from Figure 24. Since that time, relocation of the inlet channel to the northeast has been considered on numerous occasions in an effort to reduce erosional pressure on the inlet frontage. The damage to boardwalk, roads, bulkheads and buildings during the winter storms of 1991-1992 reiterate the need to review shore protection ideas in the inlet.

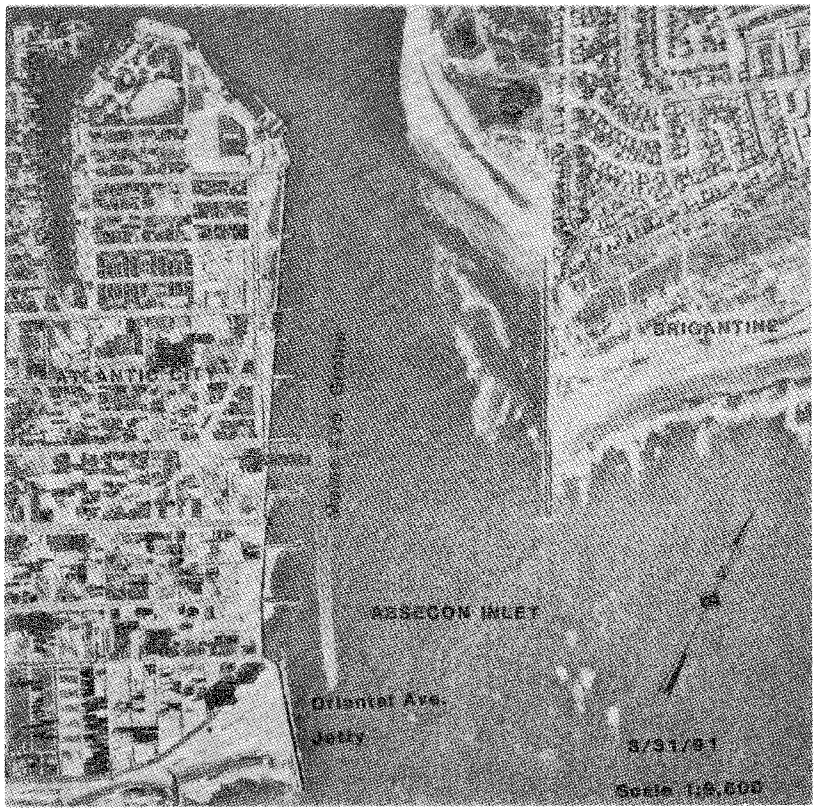
246. Plans will be formulated which will address the damage mechanisms along the inlet frontage.



Absecon Inlet, NJ
South Side (Atlantic City)
Looking N-NW
19 December 1992

Figure 23

Figure 24


BRIGANTINE
ATLANTIC CITY
Maine Ave. Groin
ABSECON INLET
N
Oriental Ave.
Jetty
3/31/91
Scale 1:9,600

247. Absecon Island Oceanfront. Of all the New Jersey barrier islands, Absecon Island historically suffers the greatest damage during coastal storms. As shown earlier in Table 15, Atlantic City has received several large beachfills since at least 1936 in an effort to maintain a beach along the northern end. A series of groins is in place in an attempt to stabilize the shoreline, especially in the area of Martin Luther King Blvd. where the shoreline geometry begines to change.

248. To the south of Atlantic City, the communities of Ventnor and Margate have very gently sloping, low elevation beaches with berm widths of approximately 50 to 150 ft. The low elevation became quite evident during the recent storms when flooding from the ocean side occurred despite the bulkheads. The majority of residential structures on Absecon Island are older homes built on slab foundations. This type of foundation is known to be less resistant to the damaging forces of major storm events.

249. The Borough of Longport is a narrow barrier island community poised precariously in Great Egg Harbor Inlet as seen in Figures 25 and 26. These figures also show how changes in beach width can occur. Note the cul-de-sac and location of homes at the southernmost end. Presently, subaerial beach is virtually nonexistent in many sections of the borough, nor are there any dunes. Protection is in the form of a curved face concrete seawall and timber bulkhead. A portion of the bulkhead failed during the storm of 4 January 1992 with subsequent damage to property in the vicinity of 32nd Street. Although massive, the concrete seawall has sufferred failure in the past due to undermining.

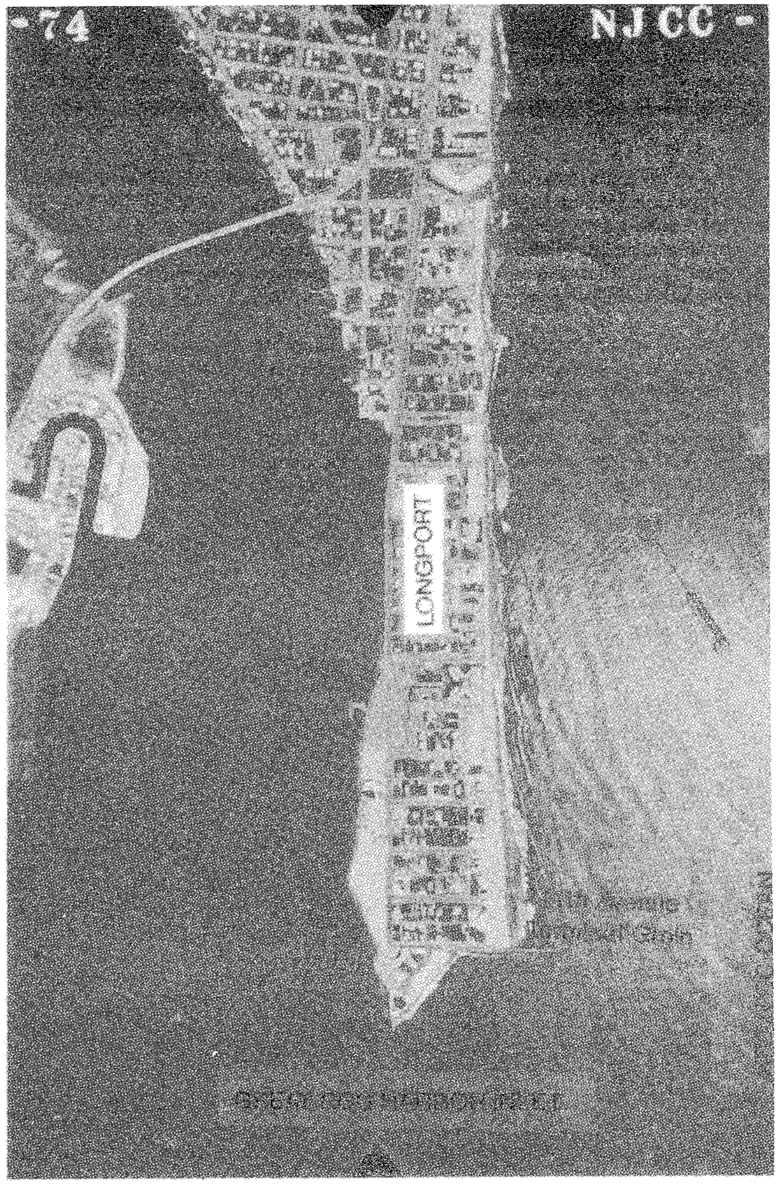
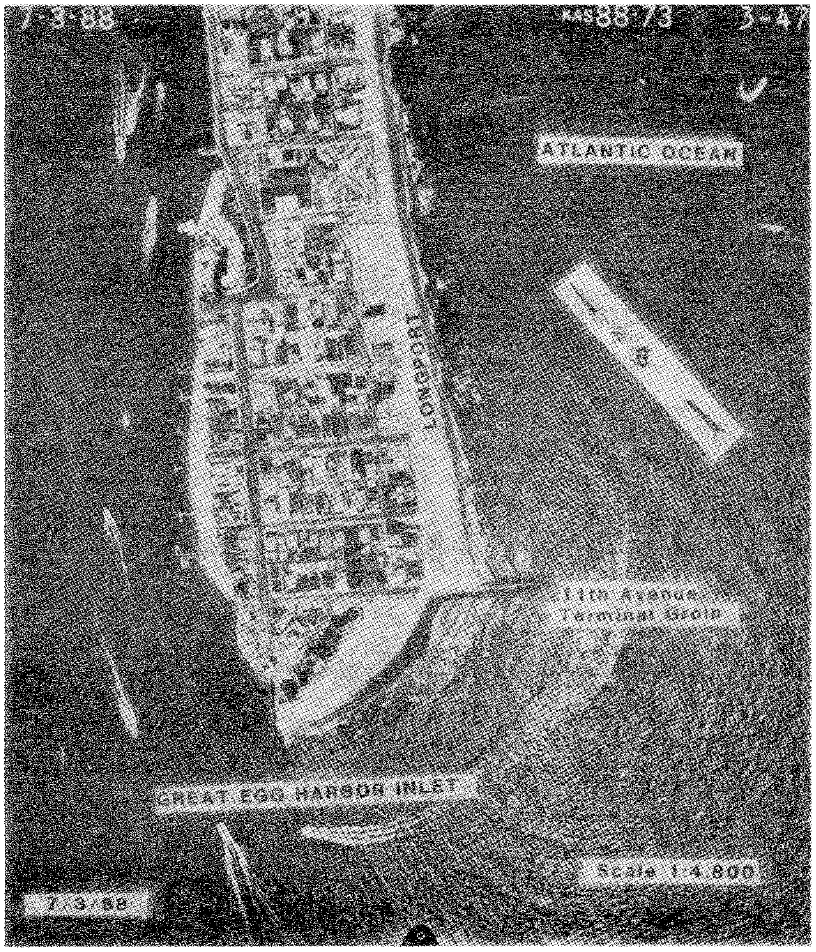

-74
NJ CC -
LONGPORT
11th Avenue
Outfall Drain
GREAT EGG HARBOR INLET

Figure 25

Figure 26


7-3-88
KAS 88-73
3-47
ATLANTIC OCEAN
LONGPORT
11th Avenue
Terminal Groin
GREAT EGG HARBOR INLET
Scale 1:4,800
7/3/88

WITHOUT PROJECT CONDITIONS

250. The without project condition for this study made certain assumptions. The assumptions that follow were used in determining the future condition of the study area for the fifty year period following the base year which is 2001.

1) Long term erosion will continue with no action by local concerns to correct or reduce the erosion until the erosion reaches a fixed point. That point is usually a bulkhead or other shore protection structure.

2) Replacement of damaged structures is assumed to be in kind for both buildings and shore protection structures.

WITHOUT PROJECT HYDRAULIC ANALYSIS

251. STORM EROSION, INUNDATION AND WAVE ATTACK ANALYSES. Storm erosion, inundation and wave attack analyses were conducted for the Absecon Island oceanfront and inlet shorelines to determine the potential for erosion caused by waves and elevated water levels which accompany storms. Storm-induced erosion and coastal flooding is first evaluated for the without project or "no-action" condition, which is a projection of existing conditions in the base year of 2001. Similar analyses will then be conducted using selected alternatives for the with project conditions.

252. Factors Influencing Storm Effects. A brief summary of the mechanisms which result in beach and community erosion and inundation from coastal storms is provided in this section. Although wind, storm track, and precipitation are the primary meteorological factors affecting the damage potential of coastal storms, the major causes of damage and loss of life are storm surge, storm duration, and wave action.

253. Under storm conditions, there is typically a net increase in the ocean water level which is superimposed on the normal astronomic tide height fluctuations. The increase in water level caused by the storm is referred to as "storm surge." The effect of storm surge on the coast depends on the interaction between the normal astronomic tide and storm-produced water level rise. For example, if the time of normal high tide coincides with the maximum surge, the overall effect will be greater. If the surge occurs at low or falling tide, the impact will likely be lessened. The term "stage" as applied in this analysis pertains to the total water elevation, including both tide and storm surge components, relative to a reference datum (NGVD, used herein). The term "surge" is defined as the difference between the observed stage and the stage that is predicted to occur due to normal tidal forces, and is thus a good indicator of the magnitude of storm intensity. Slowly moving "northeasters" may continue to build a surge that lasts through several high tides. Such a condition occurred during the devastating March 1962 storm which lasted for five high tides.

254. In addition to storm surge, a rise in water level in the near shore can occur due to wave setup. Although short period surface waves are responsible for minimal mass transport in the direction of wave propagation in open water, they cause significant transport near shore upon breaking. Water propelled landward due to breaking waves occurs rather rapidly, but water returned seaward under the influence of gravity is slower. This difference in transport rates in the onshore and offshore directions results in a pileup of water near shore referred to as wave setup. Wave setup was computed and included in this storm analysis for Absecon Island.

255. There is typically also an increase in absolute wave height and wave steepness (the ratio of wave height to wave length). When these factors combine under storm conditions, the higher, steeper waves and elevated ocean stage cause a seaward transport of material from the beach face. The net movement of material is from the foreshore seaward toward the surf zone. This offshore transport creates a wider, flatter nearshore zone over which the incident waves break and dissipate energy.

256. Lastly, coastal structures can be exposed to the direct impact of waves and high velocity runup in addition to stillwater flooding. This phenomenon will be considered wave attack for the purpose of this analysis. Reducing wave attack with a proposed project such as a beach fill would reduce the severity of coastal storm damage and also improve the utility of bulkheads and seawalls during the storm.

257. Wave zones are the regions in which at least a 3 foot wave or a velocity flow that overtops the profile crest by 3 feet can be expected to exist. These zones are the areas in which greater structural damages are expected to occur. The remaining zones are susceptible to flooding by overtopping and waves less than the minimum of 3 feet. Total water level information for the study area was compiled, and the values used as input to the economic model which ultimately computes damages associated with all three storm related damage mechanisms.

258. MODELING STORM-INDUCED EROSION. Analyses of storm-related erosion for coastal sites require either a long period of record over which the important storm parameters as well as the resultant storm erosion are quantified, or a model which is capable of realistically simulating erosion effects of a particular set of storm parameters acting on a given beach configuration. There are very few locations for which the necessary period of prototype information is available to perform an empirical analysis of storm-induced erosion. This is primarily due to the difficulty of directly measuring many important beach geometry and storm parameters, before, during, and immediately after a storm. Thus, a systematic evaluation of erosion under a range of possible starting conditions requires that a numerical model approach be adopted for the study area.

259. The USACE has developed, released and adopted the numerical storm-erosion model SBEACH (Storm induced BEAch CHange) for use in field offices (Rosati, et al., 1993). SBEACH is available via a user interface available for the personal computer, or through the Coastal Modeling System (CMS) (Cialone et al., 1992). Comprehensive descriptions of development, testing, and application of the model are contained in Reports 1 and 2 of the

SBEACH series (Larson and Kraus 1989; Larson, Kraus, and Byrnes 1990).

260. Overview of SBEACH Methodology. SBEACH Version 3.0 was used in this analysis. SBEACH is a geomorphic-based two-dimensional model which simulates beach profile change, including the formation and movement of major morphologic features such as longshore bars, troughs, and berms, under varying storm waves and water levels (Rosati, et al. 1993). SBEACH has significant capabilities that make it useful for quantitative and qualitative investigation of short-term, beach profile response to storms. However, since SBEACH is based on cross-shore processes, there are shortcomings when used in areas having significant longshore transport.

261. Input parameters include varying water levels as produced by storm surge and tide, varying wave heights and periods, and grain size in the fine-to-medium sand range. The initial beach profile can be input as either an idealized dune and berm configuration or as a surveyed total profile configuration. SBEACH allows for variable cross-shore grid spacing, simulated water-level setup due to wind, advanced procedures for calculating the wave breaking index and breaker decay, and provides an estimation of dune overwash. Shoreward boundary conditions that may be specified include a vertical structure (that can fail due to either excessive scour or instability caused by wave action/water elevation) or a beach with a dune. Output results from SBEACH include calculated profiles, cross-shore parameters, a log for each SBEACH run, and a report file.

262. SBEACH Calibration. Calibration refers to the procedure of reproducing with SBEACH the change in profile shape produced by an actual storm. Due to the empirical foundation of SBEACH and the natural variability that occurs along the beach during storms, the model should be calibrated using data from beach profiles surveyed before and after storms at the project coast or a similar coast. The calibration procedure involves iterative adjustments of controlling simulation parameters until agreement is obtained between measured and simulated profiles.

263. The best profile data set for calibration along the Absecon Island study area consisted of USACE profile surveys taken at Ocean City, NJ prior to and just after the December 1992 storm. Shoreline configuration, grain size, and coastal processes at Ocean City, NJ are similar to those for the Absecon Island study area, therefore, calibration using this well-documented pre- and post-storm data is considered sound. Additionally, a wave hindcast of the December 1992 storm (Andrews Miller, 1993) was prepared for the Philadelphia District, and water level data for the storm was recorded at the Atlantic City tide gage. Initial calibration simulations produced insufficient erosion when compared to the post-storm profile data. With CERC's assistance, minor modifications were made to the SBEACH program to allow for factors particular to the southern New Jersey coastline. Final calibration was satisfactorily completed and typical calibration plots are provided in Appendix A. Controlling simulation parameters determined for the Absecon Island study area are as follows:

$K = 2.5e\text{-}6\ m^4/N$
$EPS = 0.005 m^2/sec$
LAMM = 0.10
BMAX = 40 deg
$D_{50} = 0.24$ mm

where K is the empirical transport rate coefficient, EPS is the coefficient for the slope dependant term, LAMM is the transpot rate decay coefficient multiplier, BMAX is the maximum profile slope prior to avalanching, and D_{50} is the effective grain size.

264. Development of Input Data for Storm Erosion Modeling. Transects were selected representing the "average" shoreline, structure, backshore configuration, and upland development conditions for various reaches in the study area. Storm erosion and inundation were computed relative to both a designated baseline and reference line. The reference line lies 200 ft seaward of the baseline as shown in Figure 27. The erosion results presented later in this section are provided relative to the reference line.

Baseline and Reference Line

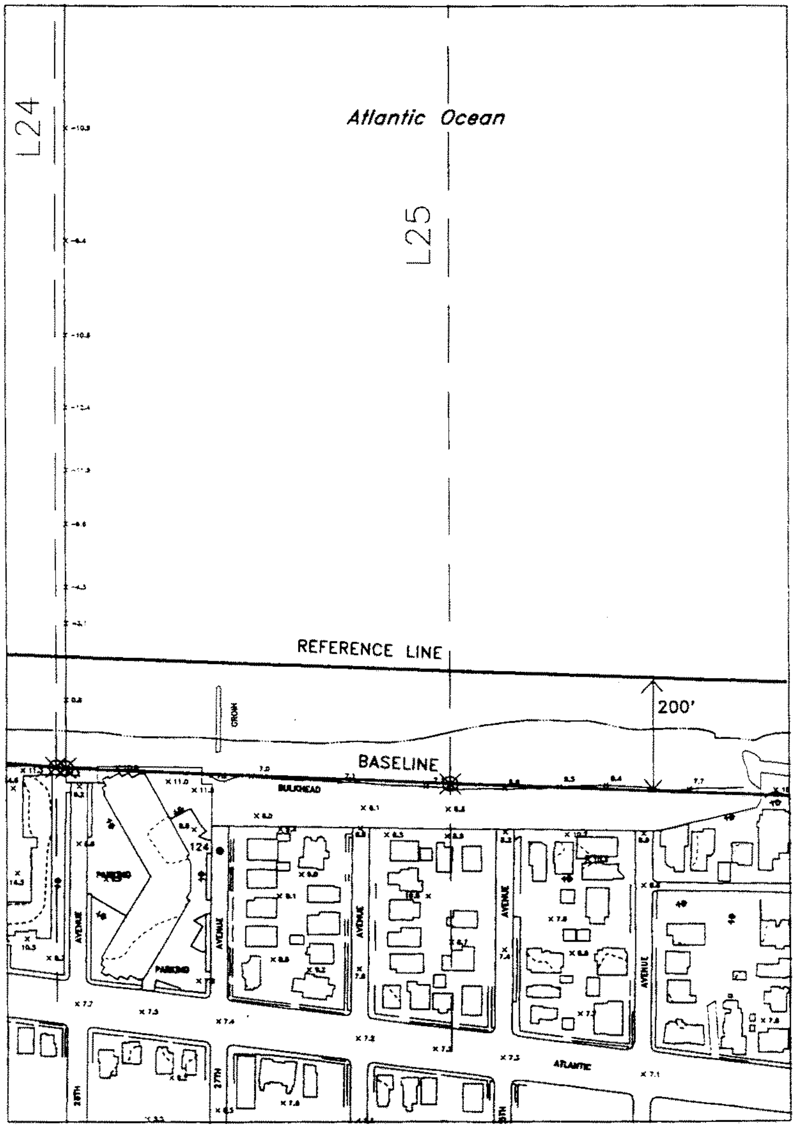


Figure 27

265. Input data was developed for all of Absecon Island with the exception of the shoreline along Absecon Inlet. This area was analyzed for inundation, erosion and wave attack separately using Shore Protection Manual methods since it does not have a profile appropriate for SBEACH's modeling capabilities. Additionally, the shoreline near the Oriental Ave. jetty and the Longport terminal groin were modelled with particular caution due to their proximity to Absecon and Great Egg Harbor Inlets, respectively.

266. Profile Data. Input beach profile data was developed from the onshore/offshore survey data collected for Absecon Island in August 1993. Six representative profiles were constructed to represent different sections of the Absecon Island shoreline as shown in Table 18. Each profile was extended landward approximately 1000 ft, using digital photogrammetry data, to allow for erosion and inundation computations into the community. Plots of the surveyed profile lines and the constructed representative lines used as input to SBEACH can be found in Appendix A.

Table 18
Average Profile Line Coverage for Absecon Island Oceanfront

Representative Profile Line Number	Shoreline Represented by Profile Line
1	Oriental Ave. to Vermont Ave.
2	Vermont Ave. to Massachusetts Ave.
3	Massachusetts Ave. to Arkansas Ave.
4	Arkansas Ave. to Jackson Ave.
5	Jackson Ave. to Portland Ave.; Richards Ave. to Kenyon Ave; Sumner Ave. to the Margate/Longport boundary.
6	Portland Ave. to Richards Ave.; Kenyon Ave. to Sumner Ave.; Longport/Margate boundary to 11th Ave.

267. Based on long-term erosion effects described in the Shoreline Conditions section , the developed input profiles represent the predicted beach in the base year. Because the Atlantic City shoreline between Massachusetts and Albany Ave. has exhibited a substantial long-term erosion trend, it was necessary to estimate the location of the erosion scarp at ten year intervals from the project base year assuming a continuation of the historic erosion pattern. The long-term erosion rates used for this task were presented in Table 16. SBEACH was then run for each of the eroded profiles in 10-year intervals from the base year through a 50-year project life period.

268. Model Parameters. Various model parameters required to run SBEACH are included in the input configuration file. The configuration file is separated into five sections: A - Model Setup; B - Waves/Water Elevation/Wind; C - Beach; D - Beach Fill; and E - Seawall/Revetment. Section A (Model Setup) deals with the initial and measured profiles, grid arrangement, output parameters, and calibration parameters. Section B facilitates entry of information about waves, water elevations, and winds. Section C allows entry of basic information related to beach profile data, and Section D allows for definition of a beach fill placed on the initial profile. An example configuration file is provided in Appendix A.

269. In Section E of the configuration file, the location and failure criteria for a seawall or revetment can be entered. Unlike many other storm erosion models, SBEACH can account for the presence of a vertical structure such as a seawall or bulkhead. The majority of Absecon Island, especially Ventnor, Margate, and Longport, is fronted with a nearly continuous line of some type of bulkhead or seawall. These structures were accounted for by inputing their locations along the profile along with appropriate failure criteria by waves, water levels, and profile scour. In Atlantic City, the concrete footings of the large buildings such as the casinos were treated in the model as unfailable seawalls. The northernmost and southernmost sections of Atlantic City have intermittent private bulkheads which were considered to not represent "average" conditions for those areas.

270. Water Elevation. The water level is the most important or first-order forcing parameter controlling storm-induced beach profile change, normally exerting greater control over profile change during storms than either waves or wind. Water level consists of contributions from the tide, storm surge, wave- and wind-induced setup, and wave runup; the latter three are computed within SBEACH. Input data in this case is tide and storm surge data. The combined time series of tide and surge is referred to as the hydrograph of total water level. The shape of the hydrograph is characterized by its duration (time when erosive wave conditions and higher than normal water elevation occur) and by its peak elevation.

271. Water level input data files for representativ 5-, 10-, 20-, 50-, 100-, 200-, and 500-yr events were developed for Absecon Island as part of the wave hindcast study conducted by OCTI. The Gumbel distribution (Fisher-Tippett Type I) was used. Extrapolation to higher recurrence intervals is more uncertain and it is generally recognized that this should not be extended to recurrence intervals greater than 2-3 times the length of the period over which the population is drawn . Therefore, extrapolation to the 200 and 500-yr events will contain the most uncertainty.

272. Wave Height, Period, and Angle. Elevated water levels accompanying storms allow waves to attack portions of the profile that are out of equilibrium with wave action because the area of the beach is not normally inundated. Wave height and period are combined in an empirical equation within SBEACH to determine if the beach will erode or accrete for a time step. In beach erosion modeling, a storm is defined neither by the water level nor by the wave height or period alone, but by the combination of these parameters that produces offshore transport.

273. The SBEACH Version 3.0 allows for the input of random wave data, that is, waves with

variable height, period, and direction or angle. The storm wave data used in this analysis were generated in the OCTI wave hindcast described previously for the seven representative events. Storm wave heights, as well as water levels, were developed by rescaling hindcasted actual storm time series.

274. Storm Parameters. A variety of data sources were used to characterize the storms used in this analysis. The twenty highest ocean stages recorded at the Atlantic City tide gage between 1912 and 1994 were listed in Table 12. For each stage, additional information on the storm type causing the water surface elevation and if possible the actual storm surge hydrograph were obtained. Of the 20 highest events, 12 are northeasters and 8 are hurricanes. The duration of hurricanes along the New Jersey shore is generally less than 24 hours, while the average duration of northeasters is on the order of 40 hours, and in some cases (e.g., 5-7 March 1962) considerably longer. Though actual storm surge hydrographs are not available for all storm events, it was assumed that all hurricanes exhibit similar characteristics to one another. Northeasters demonstrate similar features; however, durations may vary significantly from storm to storm.

275. Storm Erosion Simulations. The SBEACH model was applied to predict storm-induced erosion for the Absecon Island study area. All representative storm events were run against the six average pre-storm profiles. Model output for each simulation includes a post-storm profile plot, and several report and post-processing files. Simulation results from each particular combination of profile geometry and storm characteristics yield predicted profile retreat at three selected elevation contours. In this analysis, profile retreat for any given storm event was measured landward from the proposed project construction base line to the location of the top of the erosion scarp on the beach face. Typical plots of input pre-storm profiles and the resultant post-storm profiles based on SBEACH predicted retreat are provided in Appendix A.

276. A large portion of the Absecon Island coastline is structured with some type of bulkhead or seawall. Additionally, geotubes have been placed along portions of Atlantic City as shoreline protection structures. In order for storm erosion to affect the community, the geotube, bulkhead or seawall must fail. The SBEACH simulates failure through a number of mechanisms including storm induced scour at the toe of the structure, direct wave attack, or inundation. Failure criteria for protective structures were developed based on a synthesis of available data, including design and construction information, existing condition typical cross-sections, and field inspection of the structures. The appropriate failure criteria were input to the SBEACH configuration file for each profile. Model simulations typically resulted in failure of the bulkheads by excessive water elevation at the 100, 200, and 500-year storms. The SBEACH does not have the capability to accurately model the geotube structures therefore other analysis techniques and engineering judgement were used to account for geotube failure. For the without project condition, these structures fail during the 50 year storm.

277. Analysis of Erosion Model Results. Two approaches can be taken to estimate storm-induced beach erosion: the "design-storm" and the "storm-ensemble" approach. For the storm-ensemble approach, erosion rates are calculated from a large number of historical storms and then ranked statistically to yield an erosion-frequency curve. In the design-storm approach, the

modeled storm is either a hypothetical or historical event that produces a specific storm surge hydrograph and wave condition of the desired frequency. The design-storm approach was used in the storm erosion and inundation analyses for Absecon Island. Volumetric erosion into the community per unit length of shoreline can subsequently be computed from the pre- and post-storm profiles.

278. Results of the without project storm erosion analysis are presented in Table 19. The predicted shoreline erosion positions are reported relative to the reference line. For those areas with protective structures, zero erosion into the community is reported until structure failure occurs. These erosion values were offset appropriately for various areas and were used as input to the economic model which ultimately computes storm damages associated with storm-related erosion.

Table 19
Storm Erosion Analysis
Predicted Without Project Shoreline Erosion Positions

Representative Profile	Erosion Position (ft)[1/]						
	5 yr	**10 yr**	**20 yr**	**50 yr**	**100 yr**	**200 yr**	**500 yr**
1[2/]	500	505	510	530	550	660	700
2[3/]	0	0	0	455	475	500	520
3[4/]	145	155	160	170	175	185	210
4[5/]	240	250	290	320	360	380	400
5[6/]	90	95	100	110	310	320	325
6[6/]	190	195	198	198	400	415	425

Note:
1/ Distances reported are landward erosion limits of the beach profile landward of the Reference Line.
2/ Landward edge of boardwalk located at 720 ft.
3/ Erosion for portions with geotube truncated at 0; landward edge of boardwalk at 360 ft.
4/ Unfailable seawall located at 254 ft.
5/ Landward edge of boardwalk at 295 ft.
6/ Bulkhead located at 200 ft.

279. STORM INUNDATION EVALUATION. The project area is subject to inundation from several sources including ocean waves overtopping the beach and/or protective structures as well as flooding from the back bay. The inundation can be analyzed as two separate categories: 1) Static flooding due to superelevation of the water surfaces surrounding the project area and 2) wave attack, the direct impact of waves and high energy runup on coastal structures.

280. In order to quantify the effects from flooding and wave attack, all inundation events are based on the ocean stage frequency discussed in an earlier section. Because the wave-effect contribution to total water level at the shoreline can be significant, wave setup is estimated and added to the stage-frequency curve for determination of inundation effects. Higher water elevations associated with wave runup (unique from wave setup) were also estimated at all vertical structures and profile crest locations.

281. Setup. Effects due to wave setup are considered in the inundation-stage frequency curve. In this analysis, setup was estimated using the Wave Information Study (WIS) Report 30, Shore Protection Manual techniques, and the Automated Coastal Engineering System's (ACES) routine for "Extremal Significant Wave Height Analysis." Table 20 presents the adopted total inundation stage-frequency data at selected recurrence intervals.

Table 20
Inundation Frequency
Stage Plus Wave Setup

Year Event	Annual Probability of Exceedence	Water Surface Elevation (ft, NGVD)
5	0.20	9.4
10	0.10	10.0
20	0.05	10.6
50	0.02	11.8
100	0.01	12.9
200	0.005	13.9
500	0.002	15.5

282. Runup. Wave runup was calculated using Shore Protection Manual techniques and the ACES routine for "Wave Runup and Overtopping and Impermeable Structures" and "Irregular Wave Runup on Beaches." Runup was evaluated for both vertical bulkhead structures and the curved concrete seawall, as well as irregular runup on beaches and dunes. Based on the Federal Emergency Management Agency (FEMA) methodology used in the inundation analysis, runup was evaluated to determine if it was greater than or less than the 3 ft above crest elevation criteria. Estimates of wave runup at each storm frequency were then included in the inundation analysis.

283. Flooding. The project area is subject to flooding from back bay and adjacent waterways as well as direct ocean inundation. This elevated stage flooding is referred to as back bay stillwater

flooding. Construction of a shore protection feature will not significantly reduce the flood depths caused by the elevated stage of the back bay waters. This flooding is accounted for by subtracting the residual damages due to back bay flooding from the damages caused by ocean front inundation.

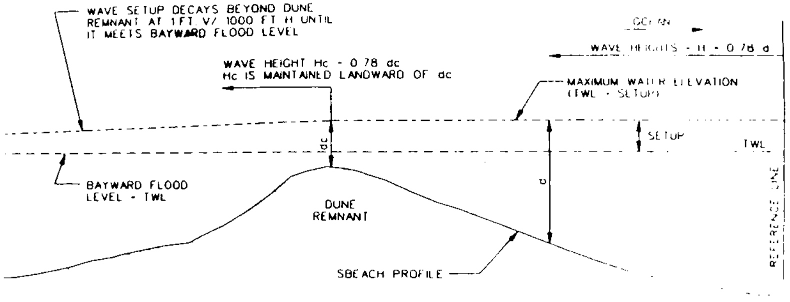
284. WAVE ATTACK. Coastal structures can be exposed to forces in addition to stillwater flooding which are attributed to the direct impact of waves and high velocity runup and overtopping. These combined phenomena will be considered the wave attack for the purpose of this analysis. The inland wave attack and inundation methodology used in this evaluation is based upon FEMA guidelines for coastal flooding analysis. The procedure divides possible storm conditions into four cases briefly described below:

> Case 1 (shown in Figure 28): Entire storm-generated profile is inundated.
>
> Case 2 (shown in Figure 29): The top of the dune/profile crest is above the maximum water level, with wave runup greater than 3 feet above the dune crest elevation.
>
> Case 3 (shown in Figure 30): The top of the dune/profile crest is above the maximum water level, with wave runup exceeding but less than 3 feet above the dune crest elevation.
>
> Case 4 (shown in Figure 31): The wave runup does not overtop the dune, the wave zone is limited to seaward of the dune.

285. Criteria for Damage. To evaluate the added potential for structural damage, the boundaries of the wave attack must be delineated, and the critical damage wave height identified. Return periods of 5, 10, 20, 50, 100, 200, and 500 years associated with the inundation-frequency curve were evaluated. The analysis estimates the location of a wave attack line and the associated zones of high energy stages. The wave attack line is the most landward position of the swash zone where the force due to waves exceeds the force required to damage typical coastal structures. Any structure located landward of this line is subject to the equivalent of stillwater flooding because the wave heights are not sufficient to cause the accelerated damages incurred seaward of the wave attack line.

286. A 3.0-ft wave height is assumed as the minimum wave that would cause damage to typical structures. This is based on the Corps of Engineers report "Guidelines for Identifying Coastal High Hazard Zones", and the FEMA's report "Guidelines and Specifications for Wave Elevation Determination and V-Zone Mapping", which both report a 3.0-ft wave height as the critical wave for damage.

CASE I
ENTIRE STORM-GENERATED PROFILE IS INUNDATED
(NO RUNUP)



dc - CONTROLLING DEPTH (MINIMUM DEPTH) OVER DUNE REMNANT

d - ANY DEPTH BETWEEN REFERENCE LINE AND dc

Hc - 0.78 dc. THIS WAVE HEIGHT IS MAINTAINED LANDWARD OF dc

H - 0.78 d. THIS IS THE HEIGHT OF WAVES BETWEEN THE REFERENCE LINE AND dc AND VARIES IN ACCORDANCE WITH VALUES OF d

WAVE ENVELOPE ABOVE COMBINED WATER LEVEL IS ESTABLISHED ON THE BASIS OF ADDING 0.7 H (OR 0.7 Hc AT AND LANDWARD OF dc) TO THE COMBINED WATER LEVEL

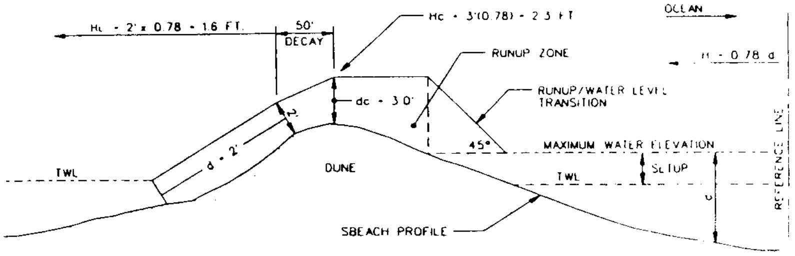
TWL - PEAK ELEVATION OF STORM SURGE PLUS ASTRONOMICAL TIDE

WAVE SETUP - WAVE SETUP GENERATED BY SBEACH MODEL

MAXIMUM WATER ELEVATION - TWL + WAVE SETUP

Figure 28

CASE II
TOP OF DUNE ABOVE COMBINED WATER LEVEL
WITH WAVE RUNUP ≥ 3.0 FT. ABOVE DUNE CREST ELEVATION



H - 0.78 d BETWEEN REFERENCE LINE AND dc

Hc - 0.78 dc AT dc

HL - LANDWARD WAVE HEIGHT - 1.6 FT LANDWARD OF POINT WHERE RUNUP DECAYS TO A DEPTH OF 2 FT (50' FROM dc - 3.0)

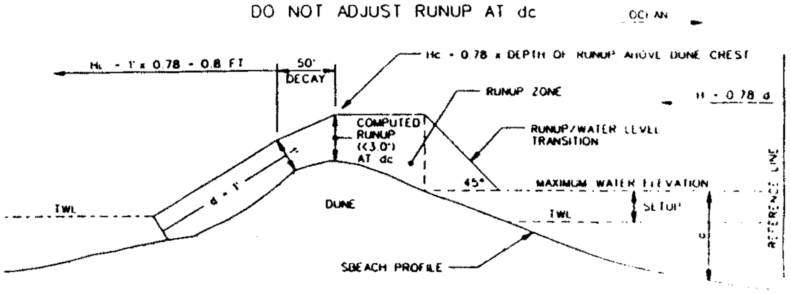
WAVE ENVELOPE (AS IN CASE I), i.e., 0.7 (H, Hc OR HL) ABOVE COMBINED WATER LEVEL OR THE WATER LEVEL ELEVATIONS AT AND LANDWARD OF dc

TWL, WAVE SETUP ARE SAME AS IN CASE I

MAXIMUM WAVE ELEVATION OVER DUNE INCLUDES WAVE RUNUP

Figure 29

CASE III
TOP OF DUNE ABOVE COMBINED WATER LEVEL
WAVE RUNUP < 3.0 FT. ABOVE DUNE CREST
DO NOT ADJUST RUNUP AT dc



H = 0.78 d BETWEEN REFERENCE LINE AND dc (COMPUTED DEPTH OF RUNUP OVER DUNE CREST)

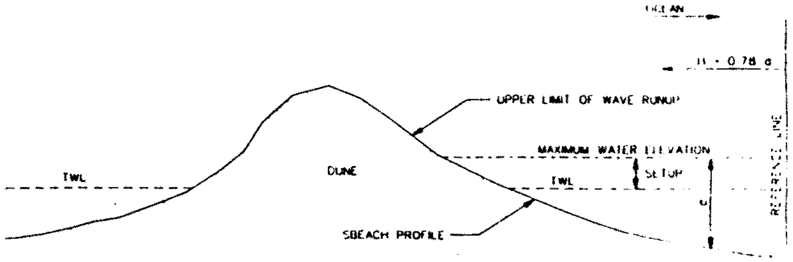
Hc = 0.78 x DEPTH OF RUNUP OVER DUNE CREST

HL = LANDWARD WAVE HEIGHT = 0.8 FT LANDWARD OF POINT WHERE RUNUP DECAYS TO A DEPTH OF 1 FT (50 FROM dc)

WAVE ENVELOPE, TWL, WAVE SETUP AND MAXIMUM WATER ELEVATION ARE SAME AS IN CASE II

Figure 30

CASE IV
WAVE RUNUP DOES NOT OVERTOP DUNE



H = 0.78 d BETWEEN REFERENCE LINE AND SEAWARD FACE OF DUNE

Figure 31

287. The bulkheads, revetments, and seawalls located in the project area reduce the direct impact from wave attack and erosion damage. For all but the most extreme events, failure of the protective structures is required for significant wave attack to occur. However, extreme waves on certain profiles can plunge over the fixed barriers and attack the adjacent structures causing significant damage. The recurrence intervals in which the protective structures will fail for each area were determined previously in conjunction with the erosion analysis.

288. WITHOUT PROJECT INUNDATION AND WAVE ATTACK RESULTS. Table21 provides an example of the computed inundation/wave profile for Atlantic City in the vicinity of Albany to Jackson Ave. Similar inundation profiles were computed for other reaches in the study area to determine the total water level along the beach profile and into the community. The effects of stage plus setup, wave amplitude, wave runup at structures or berm crest location were incorporated into the total water level. The total water level is the combination of the computed stage, the setup (which is a superelevation of the water surface at the shoreline caused by larger storm waves breaking offshore and piling up on the beachface), the amplitude of the maximum non-breaking wave that can exist within the region, and runup height above the estimated water level if waves are breaking on the beach face.

Table 21

Without Project Inundation/Wave Analysis - Typical Inundation and Wave Profile

INUNDATION PROFILE DISTANCE FROM REFERENCE LINE AND TOTAL WATER LEVEL POINTS

Storm Event	Distance from Reference Line (ft)	Total Water Elevation (NGVD)
5 Year	0	12.1
	190	10.5
	362	9.6
	433	8.8
	483	6.3
	1000	6.3
10 Year	0	12.9
	190	11.3
	362	10.4
	433	10.1
	483	8.9
	1000	6.8
20 Year	0	14.1
	190	12.5
	390	11.5
	433	11.2
	483	10.0
	1000	7.2
50 Year	0	15.9
	190	14.4
	390	13.4
	433	13.0
	483	11.8
	1000	8.2
100 Year	0	17.9
	190	16.5
	433	15.4
	483	13.8
	533	12.5
	1000	9.2
200 Year	0	19.7
	190	18.2
	433	17.2
	483	15.5
	533	14.1
	1000	10.1
500 Year	0	22.7
	160	21.4
	433	20.2
	483	18.6
	533	17.1
	1000	11.3

WAVE IMPACT ZONES - DISTANCE Landward from Reference Line (Feet)

5 Year: 270
10 Year: 280
20 Year: 320
50 Year: 415
100 Year: 490
200 Year: 680
500 Year: 900

WITHOUT PROJECT ECONOMIC ANALYSIS

289. The following section details the economic analysis performed to evaluate the damages for the without project conditions on Absecon Island. Damage categories evaluated include reduction in storm erosion and wave/inundation damages. The basic underlying assumptions include a discount rate of 7 5/8%, October 1995 price level, a 50 year project life, and a base year of 2001.

290. STRUCTURE INVENTORY AND REPLACEMENT COSTS. The study area was delineated into the following three reaches: (1.) the inlet area of Atlantic City, (2.) the oceanfront of Atlantic City, and (3.) Ventnor, Margate and Longport based on the physical setting, hydraulic and economic factors. All analyses were done on a reach by reach basis and used to calculate without project total damages. A database containing approximately 330 ocean block structures in Longport, 330 in Margate, 230 in Ventnor, 310 in Atlantic City on the oceanfront and 45 on the inlet frontage of Atlantic City was compiled. Each structure was specifically inventoried and mapped on aerial photography at a scale of 1"=50'. Information collected includes address, construction and quality type, number of stories, first floor elevations, ground elevations and foundation type. For multi-family residential and commercial structures the number of units and names of businesses were also gathered.

291. The assimilation of this data was enhanced by using aerial ortho-digital mapping and the geographic information system, MIPS (Micro Imaging Processing System). This information, along with quality and condition of a structure, was entered into the Marshall and Swift Residential and Commercial Software Estimators which calculates depreciated replacement cost value. Only the replacement cost value for the first two floors (vulnerable to storm damage) of high rise buildings and casinos were entered into the database and used to estimate damages. The associated content value of each structure was estimated to be 40% of the structural replacement cost.

292. The structure inventory consists of single family homes, multi-family dwellings such as apartment and condominium buildings, and commercial establishments such as hotel-casinos, multi-unit retail structures, arcades, malls and office and public buildings. Local officials, and redevelopment agencies have embarked upon substantial development plans for the Inlet area. Almost 200 townhouses have been constructed recently. Land acquisition and remediation has been conducted to commence construction of two mid-rise multi-unit complexes of similar construction to an existing multi-unit building (Ocean Terrace) in the area, and conceptual plans for a water park have been designed.

293. In Atlantic City, the inclusion of multi-unit commercial structures may result in higher equivalent annual damages than a database weighted with more residential structures. The database consists of over 30 structures classified as hotels/casinos, a shopping mall, and a convention center. The estimated total replacement cost for all structures is over 600 million dollars and contain 200 million dollars in content replacement cost. The average replacement cost for residential structures included in the database for Atlantic City Inlet, Atlantic City

Oceanfront, and Ventnor, Margate, Longport are $196,00, $248,000, and $294,000, respectively. The average replacement cost for commercial structures and contents (hotels/casinos; malls, etc.) included in the database for Atlantic City Inlet, Atlantic City Oceanfront, and Ventnor, Margate, Longport are $3.9, $2.9, and $1.8 million, respectively. The inventory of structures in each area extended approximately one block from the oceanfront or inlet frontage.

294. The communities of Ventnor, Margate, and Longport were evaluated as one unit due to their similarities. Land-use is primarily residential with relatively few commercial lots in proximity to the ocean. Most commercial activities are located in the resort city of Ventnor. Development is continuous along the oceanfront of Ventnor, Margate, and Longport. As shown in the table below, several hydraulic parameters or shoreline characteristics are also comparable.

Table 21A
Structure Characteristics for Ventnor, Margate and Longport

Characteristics	**Ventnor**	**Margate**	**Longport**
# of Structures/Mile	137	199	235
Type of Development	residential	residential	residential
Long Term Erosion Rate	0 ft/yr.	0 ft/yr.	0 ft/yr.
Direction of Littoral Transport	southwest	southwest	southwest
Orientation of Shoreline	northeast to southwest	northeast to southwest	northeast to southwest
Seawall/Bulkhead Fails	100 year event	100 year event	100 year event
Primary Damage Mechanism	wave-inundation	wave-inundation	wave-inundation

295. The study area was delineated into the following three reaches: (1.) the inlet area of Atlantic City, (2.) the oceanfront of Atlantic City, and (3.) Ventnor, Margate and Longport based on the physical setting, hydraulic and economic factors. All analyses were done on a reach by reach basis and used to calculate without project total damages.

296. STORM DAMAGES. Damages (for without and with project conditions) were calculated for seven frequency storm events (5, 10, 20, 50, 100, 200, and 500 year events) for erosion, wave and inundation damage to structures, infrastructure and improved property. The calculations were performed using COSTDAM. COSTDAM is a Fortran program originally written by the Wilmington District and updated for the Philadelphia District. COSTDAM reads an ASCII 'Control' file which contains the storm frequency parameters for each cell and an ASCII 'Structure' file which contains the database information of each structure as previously described. A sample of this structure file is provided in Table 22. COSTDAM checks if a structure has been damaged

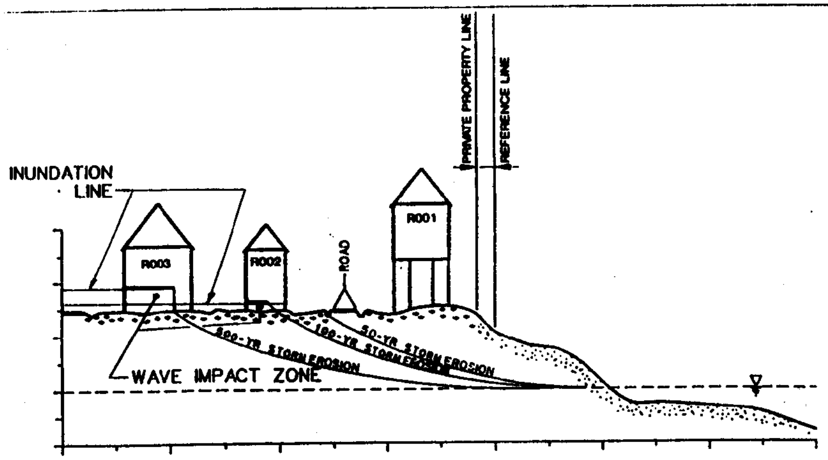
by wave attack, based on the relationship between a structure's first floor elevation and the total water elevation that sustains a wave. Then COSTDAM checks for erosion damage at a structure. Finally, COSTDAM calculates inundation damages if the water elevation is higher than the first floor elevation based on FIA depth-damage curves adjusted for increased salt water damagibility. To avoid double counting, if damage occurs by more than one mechanism, COSTDAM takes the maximum damage of any given mechanism (wave, erosion, inundation) and drops the rest of the damages from the structure's total damages. (See Figure 32 for illustration.) Average annual damages are calculated for each reach.

TABLE 22
STRUCTURE FILE EXCERPT

```
V152230          271.3  289.2 10.9 4.0   221.    88.S03S04 1-1
V152231          309.6  332.7 10.5 7.0   290.   116.S07S08 1-1
V152232          370.0  389.3 10.4 3.2   293.   117.S03S04 1-1
V152233          416.1  436.7 10.4 3.1   188.    75.S03S04 1-1
M163000          418.8  436.8  9.7 3.9   237.    95.S03S04 1-1
M163001          368.1  386.3 12.4 2.5   250.   100.S03S04 1-1
M163002          307.9  331.4 10.3 0.3   266.   106.S07S08 1-1
M163003          256.3  280.9 10.6 2.7   298.   119.S07S08 1-1
M163004          218.9  235.9 10.4 3.1   273.   109.S03S04 1-1
M163005          212.2  225.2 10.4 2.7   256.   102.S03S04 1-1
M163006          264.5  281.7 10.8 3.6   322.   129.S07S08 1-1
```

Columns 1-3 contain the Cell ID (format-A3).
Columns 4-9 contain the Structure ID (format-A6).
Columns 10-19 are blank.
Columns 20-27 contain distance to front of structure (format-F8.1)
Columns 28-35 contain distance to middle of structure (format-F8.1)
Columns 36-40 contain the ground elevation (format-F5.1)
Columns 41-44 contain the distance between the first floor and the ground (format-F4.1)
Columns 45-53 contain the structure replacement cost value (format-F9.0)
Columns 54-62 contain content replacement cost value (format-F9.0)
Columns 63-65 contain the structure depth damage curve (format-A3)
Columns 66-68 contain the content depth damage curve (format-A3)
Columns 69-70 contain a code to make structure "active" (format-I2)
Columns 71-72 contain the damage category (format-I2)

Without Project Damage Mechanisms



CROSS-SECTION VIEW WITHOUT PROJECT

PERCENT DAMAGED						
HOUSE	50 YEAR STORM		100 YEAR STORM		500 YEAR STORM	
	EROSION	WAVE / INUN.	EROSION	WAVE / INUN.	EROSION	WAVE / INUN.
R001	100%	0	100%	0	100%	0
R002	0	1%	50%*	13%	100%	0
R003	0	1%	0	13%	57%*	28%

* TAKE SINGLE HIGHEST DAMAGE PERCENTAGE ONLY TO PREVENT DOUBLE COUNTING

Figure 32

297. **EROSION DAMAGES. The distance between the reference (profile) line and the oceanfront and back walls were measured in AutoCAD using the georeferenced MIPS mapping of the study area. This technique reduces the amount of human error and photographic distortion relative to the technique used in the reconnaissance study. For the structure damage/failure analysis, it was assumed that a structure is destroyed at the point that the land below the structure is eroded halfway through the structure's footprint if the structure is not on a pile foundation.** If the structure is on piles, the land below the structure must have eroded through the footprint of the structure before total damage is claimed. Prior to this, for both foundation types, the percent damage claimed is equal to the linear proportion of erosion under the structure's footprint relative to the total damage point.

298. For townhouse/rowhouse structures perpendicular to the ocean, each unit has unique ocean and back wall distances due to the local building ordinance which mandates that every unit have two hour firewalls. These walls should provide enough stability that townhouse units in a building can remain standing and be utilized after the unit(s) closer to the ocean is/are damaged. This has no bearing on townhouse units parallel to the ocean which would all have the same erosion point, because they are essentially equal distance from the reference line. Other multi-family structures, such as apartments and condominiums, will not have unique erosion points for each unit, because most of these structures were built before the local ordinance mandating firewalls was in place. Large high rise structures, such as apartment buildings, hotels and casinos, are not subjected to total erosion damage by undermining because of their deep piled foundations.

299. In addition to erosion damage to structures, damage to the land the structures are on (hence forth called improved property) was calculated. The improved property value was determined by comparing market value of the improved property to the cost of filling in the eroded land for reutilization and using the least expensive of the two values. The cost of filling/restoring the improved property is based on a typical 100'x50' lot for the different depths, widths and cubic yards of erosion produced by storms. The cost of filling/restoring the eroded improved property was determined to be the cheaper of the two and the cost of fill was prorated for the width of each reach to estimate total damages.

300. Erosion damages for infrastructure are also calculated. The infrastructure damage category included damage to roads, utilities, the boardwalk, bulkhead, and geotubes. The replacement cost of infrastructure does not necessarily relate to the number of structures in the area. Road and utilities replacement costs consisted of fixed and variable costs based on ranges of feet of replacement/repair. In general, the replacement cost of roads decreased with greater quantities eroded reflecting economies of scale. Distance from a reference line (back of the boardwalk) and feet of erosion per event for each road and associated utilities were used to determine damage susceptibility. Atlantic City alone has over sixty streets which are perpendicular to the boardwalk.

301. The boardwalk in Atlantic City is approximately 18,000 feet long and ranges in width from 20 feet to 60 feet, for which replacement costs ranged from $315 to $3,925 per linear foot. The following criteria were used to determine boardwalk damage susceptibility: (1) if the reference point for the boardwalk was within the wave zone for an event; (2) if the wave zone extended

beyond the front of the boardwalk; and (3) if the water elevation was greater than or equal to the boardwalk elevation. Bulkhead damage was based on selection by hydraulic engineers of a probable damage/failure event. Costs to replace bulkheads are estimated to be $900 per linear foot. Geotubes were placed on the beach in Atlantic City for erosion protection at an approximate cost of $57 per linear foot. Geotube failure was determined to occur by the 50-year storm event.

302. Damage to infrastructure and the boardwalk in particular has historically been significant, especially in Atlantic City. Boardwalk damage constituted 40% of the $330,000 in municipal damages caused by the March 1984 storm. The December 1992 storm caused approximately $1.2 million dollars in municipal damage to Atlantic City. Several hundred feet of the boardwalk was destroyed or damaged. These damage estimates represent claims considered eligible by the Federal Emergency Management Agency (FEMA) and not all costs incurred from the storms.

303. IMPROVED PROPERTY DAMAGES. Annual damages for without project conditions of improved property are provided in Table 23.

Table 23

Improved Property Without Project Expected Annual Damage (In $000s, March 1994 Price Level)	
Reach	Annual Damages
Atlantic City Inlet	0
Atlantic City Oceanfront	130
Ventnor, Margate, Longport	256
Total Improved Property Damage	386

304. Erosion damages for infrastructure are also calculated. Costs to replace the bulkheads were estimated to be $900/linear foot. The replacement cost of roads was not a fixed value and decreased with greater quantities eroded reflecting economies of scale. The total without project annual damages for developed property and infrastructure including roads, utilities, bulkhead and boardwalk, are provided in Table 24.

Table 24

Infrastructure Without Project Expected Annual Damage (In $000s, March 1994 Price Level)	
Reach	Annual Damages
Atlantic City Inlet	187
Atlantic City Oceanfront	2,309
Ventnor, Margate, Longport	660
Total Infrastructure Damage	3,156

305. WAVE-INUNDATION DAMAGES. A structure is considered to be damaged by a wave when there is sufficient force in the total water elevation to completely damage a structure. Partial wave damages are not calculated; instead the structure is subjected to inundation damages. Large masonry structures like high rise condominiums will not experience failure by wave damage. Because of the large presence of such structures along the oceanfront in Atlantic City, no wave damages are present. On the contrary, the residential communities of Ventnor, Margate,

and Longport have typical frame single family beach houses along the oceanfront that do experience wave damage.

306. The percentages of total replacement cost used to calculate damages by the depth-damage function curves for inundation damages reflect various characteristics of a structure. The depth-damage curves display the percent of damage at various depths relative to the first floor. Examples of the depth-damage curves are displayed in Table 25. The depth-damage curves used to estimate the damage to structures were derived from previous studies of saltwater areas and FIA (Federal Insurance Administration) curves. The distinguishing characteristics were construction type (frame, concrete block, or masonry) and number of stories in a structure.

307. Depth Damages. Over 1,200 structures were included in the economic analysis database. The structure inventory consists of single family homes, multi-family dwellings such as apartment and condominium buildings, and commercial establishments such as hotel-casinos, multi-unit retail structures, arcades, malls and office and public buildings. Local officials, and redevelopment agencies have embarked upon substantial development plans for the Inlet area. Almost 200 townhouses have been constructed recently. Land acquisition and remediation has been conducted to commence construction of two mid-rise multi-unit complexes of similar construction to an existing multi-unit building (Ocean Terrace) in the area, and conceptual plans for a water park have been designed. In Atlantic City, the inclusion of multi-unit commercial structures results in higher equivalent annual damages than a database weighted with more residential structures. The database consists of over 30 structures classified as hotels/casinos, a shopping mall, and a convention center. The estimated total replacement cost for all structures is over 600 million dollars and contain 200 million dollars in content replacement cost. The average replacement cost for residential structures included in the database for Atlantic City Inlet, Atlantic City Oceanfront, and Ventnor, Margate, Longport are $196,00, $248,000, and $294,000, respectively. The average replacement cost for commercial structures and contents (hotels/casinos; malls, etc.) included in the database for Atlantic City Inlet, Atlantic City Oceanfront, and Ventnor, Margate, Longport are $3.9, $2.9, and $1.8 million, respectively. The inventory of structures in each area extended approximately one block from the oceanfront or inlet frontage. Most structures are located within 700 feet of the reference line. Structures are susceptible to wave-inundation, and erosion damages. Wave-inundation damage is more prevalent than erosion due to the presence of shore protection structures such as bulkheads, geotubes, and seawalls. Ninety-five percent of the damage is attributed to wave-inundation and 5 percent is due to erosion.

TABLE 25
EXAMPLE DEPTH DAMAGE RELATIONSHIPS

S03 (2 story, no basement, residential structure)

Depth	Damage (expressed as a decimal)
-2	0
-1	.01
0	.10
1	.24
2	.30
3	.36
4	.39
5	.42
6	.47
7	.49
8	.56
9	.64
10	.67

S15 (1 story, masonry, no basement, commercial structure)

Depth	Damage (expressed as a decimal)
-2	0
-1	.01
0	.05
1	.21
2	.29
3	.38
4	.46
5	.48
6	.53
7	.55
8	.59
9	.67
10	.73

308. BACK BAY RESIDUAL DAMAGES. COSTDAM was also run for the stages associated with the back bay (still-water) inundation to determine the corresponding damages. The results, listed in Table 10, represent inundation damages that will not be eliminated by a project on the oceanfront of Longport. These back bay induced residual damages total $223,000 in annual damages. This avoids overestimating benefits in the with project condition for those cases where damages are reduced or eliminated for structures once eroded or damaged by wave but may still incur some damages due to inundation from the back bay.

Table 26

Longport Back Bay Still Water Inundation (In $000s, March 1994 Price Level)	
Reach	Annual Damages
Longport	$223

309. STRUCTURE DAMAGES. Table 27 displays equivalent annual damages for structures in Atlantic City inlet frontage, Atlantic City oceanfront, and Ventnor, Margate, Longport, respectively. Annual damages for Atlantic City inlet and Atlantic City oceanfront are $422,000 and $2,738,000, respectively. Annual damages for Ventnor, Margate, Longport are $5,159,000.

Table 27

Structures Without Project Expected Annual Damage (In $000s, March 1994 Price Level)	
Reach	Annual Damages
Atlantic City Inlet	422
Atlantic City Oceanfront	2,738
Ventnor, Margate, Longport	5,159
Total Structure Damage	8,319

310. EMERGENCY/CLEAN-UP COSTS. Clean-up costs for individual structures are based on the time for clean-up and additional meal and travel costs. Travel and meal costs are included as opposed to evacuation costs because the vast majority of residential structures and even many commercial structures are occupied only on a seasonal basis, and even then, not by the structure's owner. Clean-up costs are only applied to those structures affected by a particular storm event.

311. Emergency and clean-up costs are also calculated for public entities, including local, county and state governments and non-profit emergency service organizations. These costs are based on Federal Emergency Management Agency (FEMA) Damage Survey Reports for the March 1984 and December 1992 storms, which had stage frequencies of approximately 10 and 20 year events. Because of the lack of historical information, emergency and clean-up costs for larger events are extrapolated.

312. The number of structures affected and the associated emergency costs for each storm event are in Table 28. Average annual damages for (all affected) individuals in Atlantic City inlet, Atlantic City oceanfront, and Ventnor, Margate, Longport are $2,000, $13,000 and $29,000, respectively. Average annual damages for (all affected) public entities are $5,000, $112,000, and $106,000 respectively.

Table 28

Structures Affected and Emergency/Clean-up Costs
(in $000s, March 1994 Price Level)

ATLANTIC CITY INLET	5yr	10yr	20yr	50yr	100yr	200yr	500yr
Structures	11	12	13	15	32	35	41
Individual Clean-up Costs $	4	5	6	11	28	57	117
Municipal Clean-up Costs $	3	6	25	50	103	227	289
ATLANTIC CITY OCEANFRONT	5yr	10yr	20yr	50yr	100yr	200yr	500yr
Structures	31	69	114	174	199	231	254
Individual Clean-up Costs $	12	27	44	111	231	475	959
Municipal Clean-up Costs $	87	174	717	1062	2417	3379	5330
VENTNOR, MARGATE, LONGPORT	5yr	10yr	20yr	50yr	100yr	200yr	500yr
Structures	32	120	242	325	749	851	890
Individual Clean-up Costs $	12	46	93	218	600	1239	2493
Municipal Clean-up Costs $	97	194	518	705	3015	4041	4859

TOTAL AVERAGE ANNUAL CLEANUP COSTS

ATLANTIC CITY INLET:	(all) Individuals:	$2,000
	Public entities:	$5,000
ATLANTIC CITY OCEANFRONT:	(all) Individuals:	$13,000
	Public entities:	$112,000
VENTNOR, MARGATE, LONGPORT:	(all) Individuals:	$29,000
	Public entities:	$106,000

313. **TOTAL ANNUAL WITHOUT PROJECT DAMAGES.** Total annual damages for structures, infrastructure and improved property is displayed by cell in Table 29.

Table 29

Total Damages for All Categories
Without Project Expected Annual Damage
(In $000s, March 1994 Price Level)

Reach	Annual Damages
Atlantic City Inlet	609
Atlantic City Oceanfront	5,177
Ventnor, Margate, Longport	6,075
Total Damages	11,861

PLAN FORMULATION

314. The purposes of the Plan Formulation section are to provide background on the criteria used in the formulation process, to present the procedures followed in evaluating various alternatives, and the subsequent designation of the selected plan. The formulation process involved establishment of plan formulation rationale, identification and screening of potential solutions, and assessment and evaluation of detailed plans which are responsive to the identified problems and needs.

PLANNING OBJECTIVES

315. General planning objectives for the Absecon Island study are to take an integrated approach to the solution of the erosion and inundation problems along the oceanfront of Atlantic City, Ventnor, Margate and Longport, and problems of storm vulnerability along Atlantic City's Absecon Inlet frontage. The study will strive to:

1. meet the specified needs and concerns of the general public,

2. respond to expressed public desires and preferences,

3. be flexible to accommodate changing economic, social and environmental patterns and changing technologies,

4. integrate with, and be complementary to, other related programs in the study area, and

5. be implementable with respect to financial and institutional capabilities and public support.

316. Specific objectives include the following:

1. Reduce the impacts of long term erosion along the ocean beaches of Absecon Island,

2. improve the retention of beach nourishment in Atlantic City and Longport,

3. improve the stability and longevity of beaches and shore protection structures,

4. reduce the incidence of storm flooding and wave damage along both the Absecon Island ocean and inlet frontages,

5. reduce maintenance of hardened shore protection structures found along the shoreline,

6. preserve recreational and commercial boating opportunities through Absecon and Great Egg Harbor Inlets,

7. enhance recreational beach use opportunities along the Absecon Island as an incidental benefit, and

8. where possible, preserve and maintain the environmental character of the areas under study, including such considerations as aesthetic, environmental and social concerns, as directly related to plans formulated for implementation by the Corps.

PLANNING CONSTRAINTS

317. Planning constraints are policy, technical, or institutional considerations that must be considered to successfully meet the planning objectives. The formulation of all alternative shore protection designs will be conducted in accordance with all Federal laws and guidelines established for water resources planning.

318. TECHNICAL CONSTRAINTS. These constraints include physical or operational limitations. The following criteria, within a planning framework, were adopted for use in plan formulation:

1. Federal participation in the cost of restoration of beaches shall be limited so that the proposed beach will not extend seaward of the historical shoreline of record.

2. Natural berm elevations and foreshore beach slopes should be used as a preliminary basis for the restoration of beach profiles.

3. The design tide and wave data are based on calculations and investigations as detailed in the Existing Conditions section of this report. The design of protective structures should, as a minimum, demonstrate that they will satisfactorily perform for design events up to and including the annual frequency which has a 50 percent probability of being exceeded during the economic life of the feature.

4. Plans must represent sound, safe, acceptable engineering solutions.

5. Plans must comply with Corps regulations.

6. Analyses are based on the best information available using accepted methodology.

319. ECONOMIC CONSTRAINTS. Economic constraints limit the range of alternatives considered. The following items constitute the economic constraints foreseen to impact analysis of the plan to be considered in this study and any subsequent formulation of alternatives.

1. Analyses of project benefits and costs are conducted in accordance with Corps of Engineers' guidelines and must assure that any plan is complete within itself, efficient and safe, and economically feasible in terms of current prices.

2. Economic evaluations of project modifications must assume that authorized dimensions are maintained and will evaluate the incremental justification of modifications.

3. To be recommended for project implementation, tangible benefits must exceed project economic costs. Measurement shall be based on the NED benefit/cost ratio being greater than 1.0.

4. The benefits and costs are expressed in comparable quantitative economic terms to the maximum practicable extent.

a. The costs for cycles 1 & 2 alternative plans of development were based on preliminary designs and investigations, estimates of quantities, and January 1994 price levels. Annual charges are based on a 50-year amortization period and an interest rate of 8.0 percent. The annual charges also include the cost of maintenance and replacement.

b. The costs for cycle 3 alternative plans of development were based on detailed designs and investigations, estimates of quantities and costs, and October 1995 price levels. Annual charges are based on a 50-year amortization period and an interest rate of 7 5/8 percent. The annual charges also include the cost of maintenance and replacement.

320. REGIONAL AND SOCIAL CONSTRAINTS.

1. The needs of other regions must be considered, and one area cannot be favored to the unacceptable detriment of another.

2. Consideration should be given to public health, safety, and social well-being, including possible loss of life.

3. Plans should minimize the displacement of people, businesses and livelihoods of residents in the project area.

4. Plans should minimize the disruption of normal and anticipated community and regional growth.

321. INSTITUTIONAL CONSTRAINTS. The formulation of alternative projects will be conducted in accordance with all Federal laws and guidelines established for water resources planning. According to the Planning Guidance Notebook (ER 1105-2-100), Section IV--Shore Protection, "Current shore protection law provides for Federal participation in restoring and protecting publicly owned shores available for use by the general public." Typically, beaches must be either public or private with public easements/access to allow Federal involvement in providing shoreline protection measures. Private property can be included, however, if the "protection and restoration is incidental to protection of publicly owned shores or if such protection would result

in public benefits". Items which can affect the designation of beaches being classified as public include the following:

1. A user fee may be charged to aid in offsetting the local share of project costs, but it must be applied equally to all.

2. Sufficient parking must be available within a reasonable walking distance on free or reasonable terms. Public transportation may substitute for, or compliment, local parking, and street parking may only be used if it will accommodate existing and anticipated demands.

3. Reasonable public access must be furnished to comply with the planned recreational use of the area.

4. Private beaches owned by beach clubs and hotels cannot be included in Federal shore protection activities if the beaches are limited to use by members or paying guests.

5. Publicly owned beaches which are limited to use by residents of the community are not considered to be open to the general public and cannot be considered for Federal involvement.

322. ENVIRONMENTAL CONSTRAINTS. Appropriate measures must be taken to ensure that any resulting projects are consistent with local, regional and state plans, and that necessary permits and approvals are likely to be issued by the regulatory agencies. Further environmental constraints relate to the types of flora and fauna which are indigenous and beneficial to the ecosystem. The following environmental and social well-being criteria were considered in the formulation of alternative plans.

1. Consideration should be given to public health, safety, and social well-being, including possible loss of life.

2. Wherever possible, provide an aesthetically balanced and consistent appearance.

3. Avoid detrimental environmental and social effects, specifically eliminating or minimizing the following where applicable:

    (1) Air, noise, and water pollution;

    (2) Destruction or disruption of man made and natural resources, aesthetic and cultural values, community cohesion, and the availability of public facilities and services;

    (3) Adverse effects upon employment as well as the tax base and property values;

(4) Displacement of people, businesses, and livelihoods; and,

(5) Disruption of normal and anticipated community and regional growth.

4. Maintain, preserve, and, where possible and applicable, enhance the following in the study area:

(1) water quality;

(2) the beach and dune system together with its attendant fauna and flora;

(3) wetlands, if any;

(4) sand as a geological resource;

(5) commercially important aquatic species and their habitats;

(6) nesting sites for colonial nesting birds.

CYCLES 1 AND 2 PLAN FORMULATION

323. Alternatives were considered separately for the two specific problem areas defined earlier, namely the Absecon Inlet frontage of Atlantic City, and the Absecon Island oceanfront which includes Atlantic City, Ventnor. Margate and Longport.

324. Alternative measures considered for implementation in the study area are classified under nonstructural measures and structural measures. Nonstructural measures are those measures which control or regulate the use of land and buildings such that damages to property are reduced or eliminated. No attempt is made to reduce, divert, or otherwise control the level of erosion. Structural measures are generally those which act to block or otherwise interfere with erosive coastal processes or which restore or nourish beaches to compensate for erosion.

325. Measures were evaluated individually and in combination on the basis of their suitability, applicability, and merit in meeting the specific objectives of the study. In addition, technical and economic feasibility and environmental and social acceptability were of significant concern in the screening of the measures. The potential for local support was not a major factor since the State of New Jersey and locals embrace both traditional and non-tradition shore protection measures if there is a probability of success coincident with prudent land usage. Many of the State's guidelines, policies and cost-sharing procedures are similar to the Federal government as well.

ABSECON INLET FRONTAGE OF ATLANTIC CITY

326. CYCLE 1 ALTERNATIVES - ABSECON INLET. Alternative cycle 1 measures

considered for this area are as follow:

1. Nonstructural Measures

- No action
- Evacuation from areas subject to erosion and storm damage
- Regulation of future development

2. Structural Measures

- Lengthen the Brigantine Jetty
- Realign the Absecon Inlet channel
- Beach restoration
- Relocation of the boardwalk
- Bulkheads with and without revetments
- Navigation type breakwater at the entrance of Absecon Inlet
- Wave breaking structure
- Perched beach using geo-tubes

327. It is noted that all the above alternatives were evaluated with the goal of providing similar storm damage protection. The following paragraphs summarize the objectives and evaluation of each of the above alternatives considered in cycle 1.

328. Nonstructural Measures. Following are discussions of the nonstructural measures considered under the Absecon Inlet cycle 1 analysis.

329. No Action. The no action alternative involves no measures to provide erosion control, recreational beach or storm damage protection to structures landward of the beach front. This alternative would not check the continuing erosion of the beaches, nor would it prevent property from being subjected to higher storm damages from beach recession, flooding and wave attack. Existing groins and jetties would continue to deteriorate, further accelerating the loss of beach. This plan fails to meet any of the objectives or needs of the study. Therefore, this alternative will not be considered in cycle 2.

330. Evacuation From Areas Subject to Erosion and Storm Damage. Permanent evacuation of existing developed areas subject to inundation involves the acquisition of lands and structures thereon either by purchase or through the exercise of powers of eminent domain, if necessary. Following this action, all commercial and industrial developments and residential property in areas subject to erosion are either demolished or relocated to another site. High rise condominiums, health care facilities and other large structures found on the inlet would require relocation. Additionally, roads, railroads, water supply facilities, electric power, and telephone and sewerage utilities would also have to be relocated. Lands acquired in this manner could be used for undeveloped parks, or other purposes, that would not result in material damage from erosion. The level of development and ongoing re-development along the inlet frontage would make this measure prohibitively expensive. Therefore, this alternative will not be considered in cycle 2.

331. Regulation of Future Development. Regulation or land use controls could be enacted through codes, ordinances, or other regulations to minimize the impact of erosion on lands which are being re-developed in the future. There are regulations in place to control future development and reduce susceptibility to damage. By restricting usage to parks or natural areas or limiting development to low cost or movable facilities, the potential growth of economic losses due to erosion could be minimized. Such regulations are traditionally the responsibility of State and local governments. This measure lends itself to relatively large, continuous undeveloped areas rather than developed areas. The re-development of the inlet area is presently occurring on the bay side and is presumably to code and meets FEMA flood insurance criteria. Therefore additional regulation to prevent virtually all re-development would have to be enacted for this option to work. This alternative will not be considered in cycle 2.

332. Structural Measures. Following are discussions of structural measures considered under the Absecon Inlet cycle 1 analysis. The first three measures were proposed previously in the Atlantic City, NJ, Beach Erosion Control Study, House Document No. 538, 81st Congress, 2nd Session, 1950.

333. Lengthen the Brigantine Jetty. The Brigantine Jetty, to the northeast of Absecon Inlet, was designed and modeled by the Corps and subsequently authorized by Congress for construction as part of a larger project. The project was re-authorized in section 605 of the Water Resources Development Act of 1986. The design length is 5,749 feet at an elevation of +8'MLW. The jetty was to serve three purposes: 1) to prevent the elongation of Brigantine Island and thus halt the southward migration of the channel, 2) to act as a breakwater which affords protection from waves, and 3) reduce shoaling in the inlet. This project was to be constructed in conjunction with dredging the northeast side of the channel, widening it and thus relocating it closer to Brigantine.

334. The existing jetty was built by the State of New Jersey in 1952 and lengthened in 1966 to a total of 3,730 feet. The present configuration of the existing jetty is accomplishing everything for which it was designed. In fact, the channel has not been dredged since 1978 and is presently deeper than the authorized depth. As noted at the time of design, a jetty such as this has the potential to starve downdrift beaches. While the present jetty does not seem to be responsible for erosion at Atlantic City, it is effectively halting transport of sand into the inlet. Therefore it can be surmised that a lengthening of the jetty by an additional 2000 feet could have adverse effects on natural bypassing.

335. Benefits which could be obtained from lengthening this structure are that it is an essential component of the channel realignment, and it would serve as a wave breaker. However, as will be seen in the next discussion, channel realignment is not an option because the new location is already deeper than the authorized 20' depth. The merits of lengthening the jetty must rest solely on reducing incident wave energy into the inlet during northeast storms. This alternative will be considered further.

336. Realign the Absecon Inlet Channel. The purpose of moving and widening the channel was to reduce tidal currents within the inlet and hence the erosional pressure on the southwestern boundary of the inlet. As mentioned earlier, this is not a viable alternative since the depth in the **new location is already deeper than the authorized depth. Water depths in the channel reach nearly -50 feet NGVD (see figure 33). The Brigantine jetty has effectively stopped southward migration of that island and Atlantic City's Maine Avenue groins stabilize the channel location. In the original design contained in House Document 94-631, the realignment option was not to be undertaken until after the jetty was built to its design length.**

Absecon Inlet Channel Depth

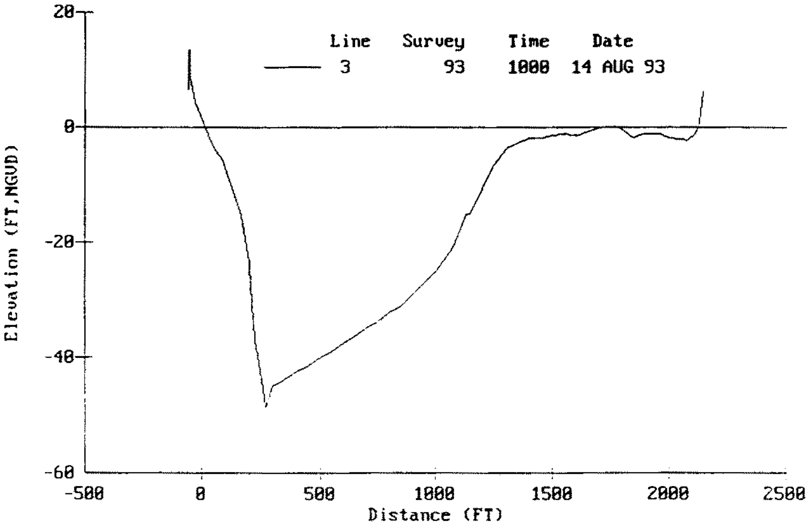


Figure 33

337. Inlet Beach Restoration. The beach restoration design found in HD 81-538 for the inlet frontage served two purposes: 1) recreation and 2) reduce wave impact. Beaches of suitable dimensions are effective in dissipating wave energy and affording protection for the upland area when maintained to properly designed berm widths and beach slopes. It was recognized however, in the authorized project, that bulkheading in this area is the more important defense against property damage. Protective beaches also remedy the basic cause of most erosion problems, that is, a deficiency in the natural sand supply which appears acute at this time.

338. The technical feasibility of this alternative in this area is questionable since the expected residence time of the beachfill is extremely short due to prevailing currents. Also, the existing slope is so steep that a tremendous quantity of sand would be required to fill the sub-aqueous portion of the beach, thus increasing the shoaling potential of the channel. The physical model tested at WES in the 1940s indicated that beachfill should only be conducted after the Brigantine Jetty is lengthened and the channel moved to the northeast. This alternative will be evaluated in cycle 2 in conjunction with lengthening the Brigantine Jetty.

339. Perched Beach Using Geo-tubes. A way to increase the residence time of a beachfill on an inlet can be to employ a perched beach concept. A sill is created, usually constructed with sand bags or geo-tubes that are located in the immediate offshore zone and run parallel to the shoreline. The sills dissipate wave energy, and thus, sand can be deposited in the region between the sills and the shoreline. The greatest advantage of beach sills is that they do not restrict the use or affect the aesthetics of the beach.

340. Disadvantages of this alternative include the questionable durability of certain components of the geo-tubes, their susceptibility to vandalism, and the depth of water at the location necessary for the structure to provide protection. The existing offshore elevation would have to be raised with beachfill, thus creating a potentially unstable foundation for the geo-tubes. Additionally, strong tidal currents would tend to undermine the tubes. Recent experiences in nearby Townsends Inlet are not favorable. Due to the considerable disadvantages, the perched beach will not be considered further to address the planning objectives of the study.

341. Relocation of the Boardwalk. A major piece of infrastructure along the inlet is the boardwalk. This structure has been repeatedly damaged during storms and repaired. One alternative to reduce this type of damage is to relocate all or portions of the boardwalk. The boardwalk which continues northwest from the Oriental Avenue Jetty is located directly in front of and above existing bulkheads and revetments for approximately 50% of its length. During storms, waves hit the bulkhead and splash upward with a force sufficient to damage the boardwalk. If the boardwalk were moved, this form of runup would cease to be a damage mechanism. However, there is little space between the existing road and the bulkhead for relocation. This alternative will be evaluated in cycle 2.

342. Wave Breaking Structure. An alternative to relocating the boardwalk is to extend the wave impact zone seaward of the boardwalk. This also removes wave induced erosion from the toe of the bulkhead and decreases wave induced superelevation at that location. The structure would be similar to a rubble revetment except that surface roughness would be maximized to dissipate wave

energy and the slope would be gradual to extend the subaerial profile seaward. This alternative will be evaluated in cycle 2.

343. Bulkhead With Revetment. A continuous bulkhead constructed along a shoreline is a viable protective measure. The primary purpose of a bulkhead is to retain or prevent erosion of upland, with the secondary purpose being to afford protection to backshore areas from wave action and inundation. Bulkheads are normally vertical walls of concrete, timber, or steel sheetpile. Depending on the wave climate to which bulkheads are exposed, beach nourishment or revetment toe protection may be a requirement in front of the bulkhead. New bulkheads would be tied in with existing bulkheads and stone groins.

344. Revetment toe protection must also be considered as part of the bulkhead alternative. A revetment is, in general, a stone or concrete face placed to protect an embankment or existing shore protection structure against erosion by wave action or currents. The bulkhead alternative along the inlet will require toe protection if other alternatives to reduce wave energy are shown not to be effective. There is the possibility that, due to settlement or erosion, the revetment could fail unless precautionary measures are taken.

345. Bulkheads along the inlet frontage have recently been refurbished (see photo #1, Appendix A) except for a 1,050 foot section between Oriental Avenue and Atlantic Avenue. This alternative will be carried into cycle 2 for this area.

346. Navigation Type Breakwater. The construction of a inlet breakwater to reduce the force of waves striking the shoreline was another protective measure considered. Offshore breakwaters are typically massive stone structures founded in relatively deep water. This alternative is similar to the extension of the Brigantine Jetty except that the movement of sand around the structure would be very different. Particular care must be taken in the design and location of the structure as erosion of the downdrift beach can occur. Gaps or breaks between structures must also be permitted to prevent the development of undesirable currents between the ends of the structures.

347. Breakwaters provide sheltered water for boating but have extremely high construction costs especially in deep water and can present a potential navigation hazard. Due to the disadvantages mentioned above, especially high construction costs, the use of a channel structure was eliminated from further consideration as a viable alternative for Absecon Inlet.

348. Cycle 1 - Applicability Screening for Absecon Inlet. During the first cycle of formulation the management measures discussed in the previous section were reviewed to determine the acceptability and potential to control erosion, wave attack and inundation in the problem area. Consideration was given to factors such as potential technical performance, whether it meets the study objectives and relative cost. Based on the information shown in Table 30, the alternative measures were screened and only those measures which were considered to have potential viability were carried forward as plans or features of plans in the next cycle of formulation.

Table 30
Absecon Inlet (Atlantic City)
Cycle 1 - First Level Screening Results

Alternative	Technical Feasibility	Meet Objectives?	Relative Cost	Further Consideration in Cycle 2?	Remarks
Nonstructural Alternatives	Partial	No	Varies	No	Could encourage development in coastal wetlands.
Beach Restoration	Partial	Partial	Moderate	Yes	Adverse environmental impacts can be minimized through coordination with environmental agencies. Existing shoreline slope may not be adequate to support stable berm. May increase inlet shoaling.
Bulkhead with revetment	Yes	Partial	Moderate	Yes	Bulkheads would require toe protection.
Navigation Type Breakwater	Partial	Partial	Very High	No	Reduces wave heights in navigation channel and on inlet shoreline. Costs must be offset by benefits to navigation and reduced periodic nourishment requirements.
Realignment of the Channel	No	No	High	No	Depth is already greater than the authorized channel throughout the inlet. Modifications may have adverse impact on channel stability.
Relocate Boardwalk	Yes	Partial	High	Yes	
Perched Beach (Geo-tubes)	Partial	Partial	High	No	Existing water depth is too deep to accommodate a perched beach with sufficient berm width to provide shore protection benefits.
Wave Breaking Structure	Yes	Partial	Moderate	Yes	Rough slope to absorb wave energy before impacting on bulkhead.
Lengthen Brigantine Jetty	Partial	Partial	Very High	Yes	May have adverse impacts on natural bypassing of sediment to Absecon Island.

349. CYCLE 2 ASSESSMENT OF ALTERNATIVES FOR ABSECON INLET. Based on the previous screening of alternatives, several plans were selected for further analysis in Cycle 2. These plans consist of one or more individual measures as appropriate to develop a suitable degree of shore protection. In addition, consideration was given to alternative methods of beach fill and periodic nourishment, various construction materials, and alternative borrow sources for sand. The following sections describe the plans considered for each problem area and discuss the technical performance, economic analyses, and environmental and social impacts associated with each plan.

350. Inlet Beach Restoration. For purposes of this evaluation, a uniform berm width of 50 feet at an elevation of +8.5' NGVD was designed for the inlet frontage. The beach nourishment alternative involves two phases. The first consists of placing the basic (minimum) protection plus any advanced nourishment. The second phase consists of nourishing and maintaining the basic protection on a periodic basis. Beach nourishment was evaluated using dredging, hydraulic pumping and mechanical methods.

351. The dredging method would use conventional floating dredge techniques with the borrow source being the ebb shoal. The sand would be pumped to the beach. The beachfill quantity used for cost estimating purposes was obtained using a typical section. More than 400,000 cubic yards of sand would be required for the inlet shoreline. Periodic nourishment was based on half the initial fill every two years.

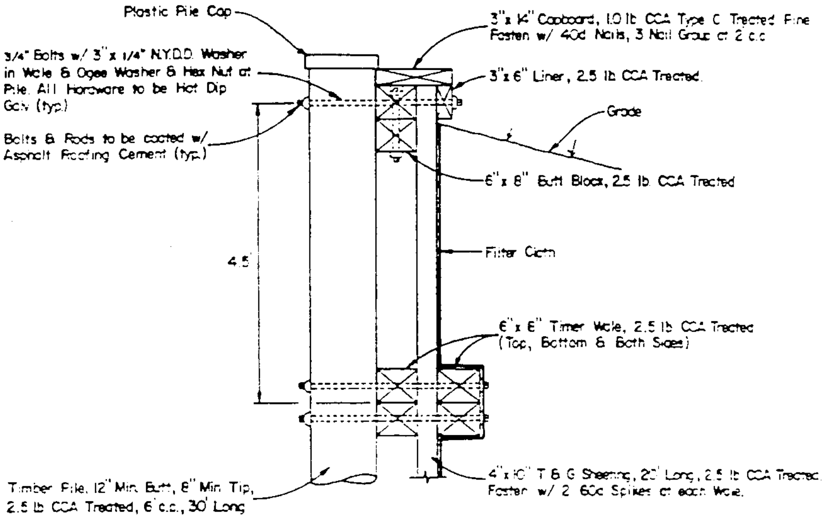
352. About 483,000 cubic yards of fill was placed along the inlet frontage in July, 1948. More than 80% of the material was lost by May, 1950. It is assumed that a similar beachfill today would suffer the same fate unless the Brigantine Jetty were extended, and the channel were completely redesigned. Because the cost of this alternative when coupled with the extension of the jetty is very nearly equal to the total annualized damages, this alternative will not be carried into cycle 3.

353. Lengthen the Brigantine Jetty. This alternative represents a costly method of reducing wave energy at the inlet frontage based on preliminary cost estimates, but may provide positive net benefits. Due to the potential for adverse downdrift starvation and the belief that wave energy can be reduced by less costly methods, this alternative may fall out during cycle 3.

354. Relocate the Boardwalk. Relocating the boardwalk removes the structure from the area where damage occurs. This alternative does nothing for the erosion, inundation and wave attack problems at the inlet. Therefore this alternative should be considered only in conjunction with other measures. The estimated cost of moving the boardwalk exceeds the total annualized damages and therefore will not be considered further.

355. Wave Breaking Structure. This alternative my be the least cost alternative to reducing incident wave energy and scour at the bulkhead. Once installed, its longevity would exceed a beachfill on the inlet. This alternative will be further evaluated in cycle 3.

356. Bulkhead With Revetment. Construction of a bulkhead with stone revetment for the remaining 1,050 feet of inlet frontage would result in a continuous level of protection along the entire inlet frontage shoreline. This alternative was designed similar to the bulkhead shown in figure 34. This alternative will be evaluated in cycle 3.



TYPICAL SECTION
BULKHEAD

Figure 34

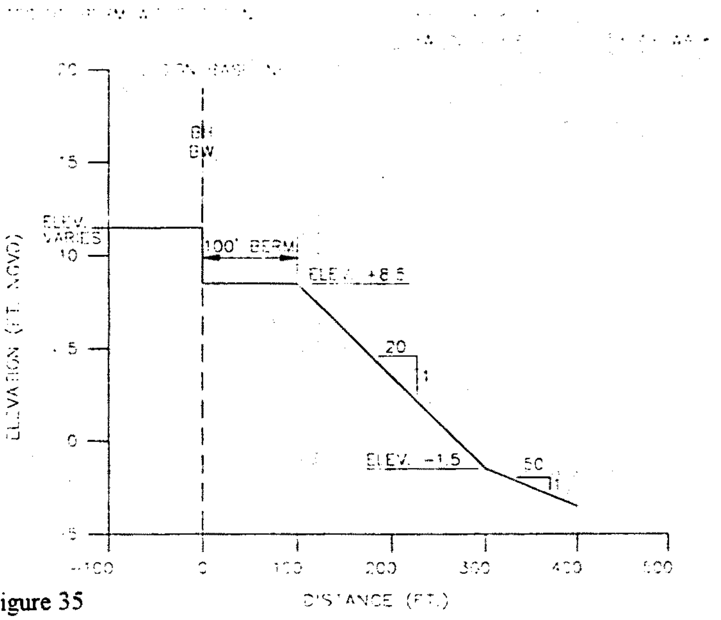


Figure 35

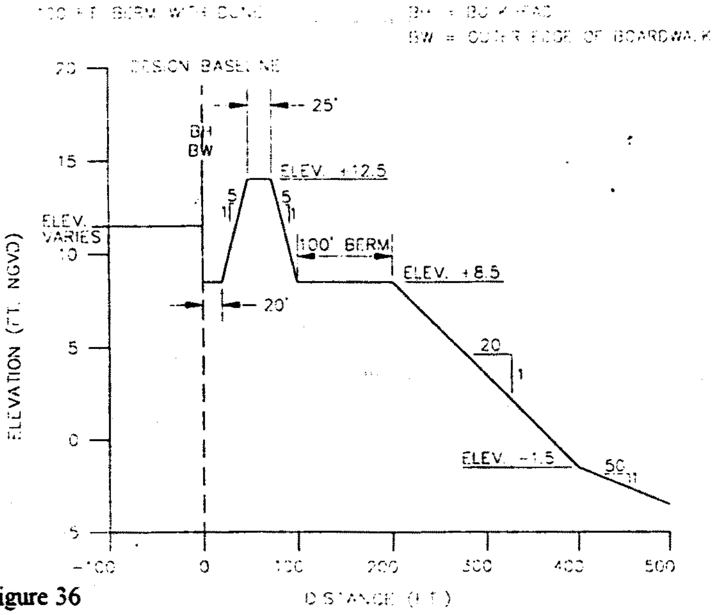


Figure 36

385. Beach Restoration With Bulkhead. In this alternative, the beachfill would not include a dune, since the bulkhead provides storm surge protection. To protect the entire length of Absecon Island at a uniform elevation would require the construction of an additional 14,075 l.f. of bulkhead. The new bulkhead would tie into the existing sections of timber bulkhead along the oceanfront. The typical bulkhead section was shown in Figure 34.

386. Since 58% of the Absecon Island ocean frontage has existing timber or concrete bulkheads and seawalls parallel to the ocean front, this alternative examined extending the timber bulkhead walls along the entire length of the study area. Under this alternative, it would require 12,700 feet of new timber bulkhead to provide a continuous line of storm protection along Atlantic City. This distance does not include those areas where the concrete foundations of casinos abut the boardwalk. Also, this does not take into account the staggered lengths of the street ends and those areas where the bulkheads facing the ocean are connected by perpendicular bulkhead sections, adding to the total bulkhead length. This is not a cost effective alternative for Atlantic City when compared to a dune, and therefore will not be included in the cycle 3 analysis.

387. In contrast, Ventnor, Margate and Longport would require approximately 1400 linear feet of bulkhead, primarily at road ends, to complete a continuous line of storm protection. This assumes that tieing into the existing bulkhead system is feasible. This alternative will be investigated further in cycle 3.

388. Another option for improving the bulkhead-seawall system for Absecon Island would involve replacing those sections that have top elevations below +9.5 NGVD and which are in poor condition (see photo #16, Appendix A). This occurs primarily at the street ends in Ventnor, Margate and Longport, as most of the residents in these communities who own beachfront property maintain the bulkheads at a top elevation of at least +9.5 NGVD and the majority are kept in fair to good condition. Approximately 25 percent of the bulkheads protecting the street ends in these shore communities would need to be replaced under this option. This results in a total length of 1400 linear feet.

389. While bulkheads will protect upland areas, beach restoration will limit erosion in front of the bulkheads and will provide additional protection to upland areas. Since bulkheads do not interact with the littoral transport, it will not reduce nourishment cycles as a groin field would. There may be institutional problems with the concept of a contiguous bulkhead line due to the potential for moving development seaward in some locations. This alternative will be evaluated in cycle 3.

390. Beach Restoration With Groins. The longevity of a beach restoration project may be short depending upon the shoreline's vulnerability and the frequency and intensity of coastal storms. Frequent renourishment of a section of beach may be required to maintain a given level of protection. The use of beach stabilization structures, such as groins, may be appropriate to increase the amount of time that placed sand remains on the beach. Economic justification for the cost of the groins or other beach stabilization structures is the savings realized by lengthening the time interval between renourishments.

391. Groins are generally constructed perpendicular to the shoreline and control the rate of

longshore transport through a project area. If properly designed, they are effective in stabilizing beaches and beach fill projects where sand is typically lost by longshore transport. Functional design of a groin or groin system should maximize the amount of material accumulated or maintained on the updrift side and minimize erosion downdrift of the structure. Important design parameters to consider include the proper siting and type of groin as well as groin length, height, crest width, alignment, spacing, and permeability.

392. The Absecon Island coastline has numerous existing groins as described in Appendix A. Detailed shoreline change modeling which includes the testing of various alternative configurations are required to properly design and optimize beach restoration and additional groin construction for the study area. However, initial recommendations for beach restoration with the use of groins have been developed for Cycle 1 and 2 level efforts. These recommendations were based on the anticipated need to stabilize beach fill at particular sections of the Absecon Island shoreline. Numerous groins and piers already exist on the Atlantic City shoreline to the northeast of the Ocean One Pier, however, no groins are present for approximately 4 miles to the southwest of Ocean One. This area has historically experienced downdrift erosion and shows substantial erosion and inundation damages for the without project conditions. Two groins at approximately 1200 ft spacing are a viable alternative to provide stabilization for beach fill in this area. No additional groins are recommended for Ventnor or Margate.

393. An additional alternative is that six stone groins be constructed in Longport to increase natural beach width and to maintain placed beach fill. Several dilapidated timber groins which are essentially no longer functional are present along Longport's shoreline. The narrow and steep beach profile in this area suggests that additional structures may be required to effectively stabilize beach restoration material.

394. Extend the Longport Terminal Groin. A cost estimate was developed for extending the terminal groin from 500 feet to 1000 feet. Because costs are less than the total damages, this alternative will be evaluated further in cycle 3. However, potential benefits to periodic nourishment may not outweigh potential negative impacts to the Great Egg Harbor Inlet ebb shoal complex.

395. Cycle 2 - Applicability Screening for Absecon Island Oceanfront. During the second cycle of formulation the measures discussed in the previous section were reviewed to determine their social and environmental acceptability and their cost effectiveness. Preliminary without project annualized damages were compared to preliminary annualized costs to ascertain the potential for positive net benefits. Both damages and costs were calculated using simplifying assumptions and are therefore subject to change in cycle 3. Based on the information shown in Table 33, the alternative measures were screened and only those measures which were considered to have potential viability were carried forward as plans or features of plans in the detailed cycle 3 plan formulation.

Table 33
Absecon Island Ocean Front
Cycle 2 - Second Level Screening Results

Alternative	Design Considerations	Environmental Considerations	Social Considerations	Preliminary Annualized Costs	Total Annualized Damages	Further Consideration in Cycle 3?	Remarks
Beach Restoration	100' Berm, +8.5 ft. NGVD.	Smother organisms. Kill organisms in borrow area. Can increase nesting and beach habitat.	Provide usable beach area.	$1,329,000	$16,025,000	Yes	Adverse environmental impacts can be minimized through coordination with environmental agencies.
Beach Restoration with Dune and Groin field	AC: Two stone groins, 1200' apart, 400' length from 10'MLW to 7' MLW at seaward end.	Same as beach restoration.	Same as beach restoration but there may be aesthetic problems with hardened structures.	$607,000 (Atlantic City only)	$6,943,000 (Atlantic City only)	Yes	Costs must be offset by reduced periodic nourishment requirements.
	Longport: Six stone groins, 100' apart, 400' length from 10'MLW to 7' MLW at seaward end.			$1,375,000 (Longport only)	$4,943,000 (Longport only)	Yes	
Beach Restoration with Bulkheading (no dune)	100' Berm, 12,700 l.f. bulkhead (Atlantic City).	Same as beach restoration.	Same as beach restoration.	$1,071,000 (Atlantic City)	$6,943,000 (Atlantic City)	No	Bulkheads perform the same function as dune but are more costly. Road ends are existing low points in elevation.
	100' berm, 1400 l.f. bulkhead at road ends (Margate, Ventnor & Longport).			$1,198,000 (Ventnor, Margate & Longport).	$9,082,000 (Ventnor, Margate & Longport).	Yes	
Beach Restoration with Dune	185' berm and dune width. Berm: +8.5 ft. NGVD. Dune: 25 ft top width, +12.5 ft. NGVD.	Same as beach restoration, in addition, enhancement of backshore environment.	Same as beach restoration but there are those who are inconvenienced by dunes.	$2,118,000	$16,025,000	Yes	Provides buffer and sediment stockpile during storms and can provide aesthetic value by planting with dune grass.
Extend Longport Terminal Groin	1000' total length.	Temporary dredging impacts such as increased turbidity and destruction of benthic habitat.		$128,000	$4,943,000 (Longport only)	Yes	Costs must be offset by reduced periodic nourishment requirements. Possible effects on the Great Egg Harbor Inlet ebb shoal.

CYCLE 3 PLAN FORMULATION

396. RECOMMENDED PLANS FOR CYCLE 3 ANALYSIS. The cycle 1 and cycle 2 screening process eliminated many of the potential alternative measures. The alternatives recommended for further consideration in cycle 3 (refer to tables 31 and 33) are listed below. In cycle 3, designs will be formulated and optimized to develop the NED plan for the two problem areas described in this report.

397. Absecon Inlet Frontage of Atlantic City.

1. Bulkheading with revetment.
2. Wave breaking structure.
3. Lengthening of the Brigantine Jetty.

398. Absecon Island Oceanfront.

1. Beach restoration.
2. Beach restoration with dunes.
3. Beach restoration with bulkheads in Ventnor, Margate and Longport.
4. Beach restoration with groins in Atlantic City and Longport.

399. Incremental Analysis. In order to properly formulate the NED plan, three discrete incremental reaches were established for cycle 3, one for the inlet frontage of Atlantic City and two for the Absecon Island oceanfront split between Atlantic City and the communities of Ventnor, Margate and Longport. The incremental reaches are based on existing economic and physical conditions, while also ensuring that the recommended project is constructable, and that each reach functions properly and independently. These reaches are based on the type and extent of development, similarities in the typical beach and upland profiles comprising the without-project condition, and background erosion rate. Also taken into account is the existence of groins, bulkheads and boardwalks. Sufficient differences exist in the without-project conditions for the three reaches to effect project optimization.

400. CYCLE 3 ALTERNATIVES - ABSECON INLET. Along the Absecon Inlet frontage in Atlantic City, most damages occur in those areas that are not protected by the existing timber bulkhead constructed along Maine Avenue, or where the bulkheads direct wave energy upwards, thereby damaging the boardwalk. In these areas, flooding and boardwalk damage occurs on a regular basis. Damages to the boardwalk are generally caused by direct wave attack, and can occur during minor storm events. The cycle 3 alternatives that were analyzed to prevent these damages include construction of a timber bulkhead to complete the line of protection along the inlet, extension of the north (Brigantine) jetty and an inshore wavebreaker.

401. Bulkheads. The bulkhead alternative consists of constructing two separate sections; one from Madison Ave. to Melrose Ave., for a length of 550 feet, and one section from Atlantic Ave. to Oriental Ave., for a length of 1,050 feet. The timber sheet-pile bulkhead would tie in to the existing bulkhead at both locations. From Atlantic to Oriental Aves., the bulkhead would be

located at the seaward edge of the existing boardwalk. Both sections of bulkhead would be constructed to a top elevation of +14 NGVD, with pile anchors and tie-backs. A revetment of rough quarrystone will be constructed to an elevation of +5 NGVD on the seaward side of the bulkhead. This bulkhead would prevent damages from inundation and wave attack. Erosion from channel migration would not be prevented by this option, however the existing groin field and double jetties serve to limit the channel from further southerly migration.

402. Wavebreaker. The purpose of this alternative is to protect the boardwalk by dissipating a large enough portion of the wave energy to remove the boardwalk from the 3 foot wave zone. The breakwater is proposed to be constructed at a location 200 feet offshore of the seaward edge of the existing boardwalk. Locating the structures further offshore reduces their effectiveness and is impractical due to existing water depths (see figure 33). Constructing the wavebreakers between the existing groins, however, leads to concerns about scour since a closed compartment would be created thereby increasing velocities through the gaps. Therefore, a low-crested elevation is preferred.

403. Three different designs were developed for the wavebreaker alternative. The location and overall conceptual design remained the same for each, but the crest elevations were varied. Top elevations were determined by taking into account the stage elevation for higher frequency events. The design consisted of separate segments constructed in the first three groin cells beginning at the Oriental Avenue jetty. Each segment would be constructed with a crest width of 12 feet, and side slopes of 1V:3H. Materials will consist of a layer of 12" size bedding stone, 50 to 100 lb. matstone, 750lb. to 1 ton corestone, and 10 to 15 ton capstone. A section of the wavebreaker is shown in Appendix A.

404. The wave transmission characteristics of a wavebreaker with a crest elevation of -0.5 feet NGVD (mean sea level) was analyzed following the methodology of Van der Meer (1991). Storm events with return periods from 5 to 500 years were investigated. The results of this analysis showed that the wave height reductions achieved by the breakwater were not sufficient to remove the boardwalk from the 3 foot damaging wave zone. Breakwaters with higher crests were investigated, but it was found that the crest elevation had to be approximately 15.0 feet NGVD to sufficiently reduce the wave height for even the most frequent storms.

405. Construction of a breakwater to such a high elevation is impractical due to scour problems and high construction costs. Additionally, this option would not prevent inundation damages. Channel migration could be slowed by this option, but only in the specific area where the wavebreakers exist. Since the existing groin field and jetties serve to keep the channel in its present location, this is not seen as a significant benefit. As can be seen in Table 34, the breakwater alternative is not justified and therefore will not be constructed.

406. Brigantine Jetty. The jetty extension consisted of adding 2000 ft to the seaward end for a total length of 5,749 ft at 8' MLW (6.5' NGVD). As described in cycle 1, the only remaining benefit gained by extending the north jetty would be a reduction in wave energy. This alternative could reduce wave heights throughout the inlet during northeasters and could result in a small reduction in inundation due to wave setup. Since the present length is effective in preventing

shoaling in the inlet, extending the jetty would almost certainly create a deficit of sand reaching the inlet littoral system. This would in turn cause adverse downdrift impacts to Atlantic City's beaches. This would also disturb the sediment budget in the inlet which is the principle source of sand for the oceanfront shore protection alternatives.

407. Sensitivity runs were performed with both the two-dimensional current model and the wave model. Analysis showed that the primary impact of lengthening the jetty was on long-term inlet processes as opposed to short-term, storm-related processes. The primary effect appears to be a reorientation of tidal currents to pass around the end of the new longer jetty. The newly directed currents will have sufficient velocity to erode the existing shoal at the end of the Brigantine jetty. Larger-scale inlet processes such as the transport to the flood tidal shoal or the ebb tidal transport around the Oriental Avenue jetty do not appear to be affected. A larger-scale possible effect may be the transfer of the ebb shoal farther offshore. A seaward shift of that shoal will provide increased sheltering of the Atlantic City shoreline. The sheltering, due to a decrease in water depth from the present 16 ft to the shoal depth of 10 ft, could be potentially significant for storm waves from the east to northeast, but appears to have a relatively insignificant potential effect on long-term longshore transport rates.

408. Wave reduction due to the jetty extension would be, for the most part, limited to the vicinity of the ebb shoal. Because storm wave heights impacting the shoreline are depth limited, damage would be prevented only during the more frequequent (less intense) storms. Therefore, extension of the north jetty provides limited benefits to the Absecon Inlet shoreline and this alternative cannot be justified.

409. WITH PROJECT ANALYSIS OF CYCLE 3 ALTERNATIVES - ABSECON INLET. Damages for Absecon Inlet with project alternatives are calculated using the same methodologies and databases as previously detailed in the without project conditions. The benefits for any given project are the difference between without project damages and with project damages. The storm damage reduction benefits (including emergency costs) are shown for all inlet alternatives in Table 34.

Table 34

Atlantic City Inlet
Storm Damage Reduction By Alternative
(March 1994 Price Level)

Alt.	Project Type	Without Project Storm Damages	With Project Storm Damages	Storm Damage Reduction Benefits	Percent Reduced
ZA	Jetty Extension	$616,000	$541,220	$74,780	12%
ZB	Bulkheads	$616,000	$184,180	$431,820	70%
ZJ	Wave Breaker	$616,000	$558,050	$57,950	9%

410. During the analysis of net benefits, figure were adjusted to the October 1995 price level. Table 35 presents the results of the comparison of average annual benefits to average annual costs for each inlet alternative.

Table 35

Atlantic City Inlet Benefit/Cost Matrix
Average Annual Benefits and Costs for With Project Alternatives
(October 1995 Price Level)

		ALT. ZA
JETTY EXTENSION	AVERAGE ANNUAL BENEFITS	$77,031
	AVERAGE ANNUAL COSTS	$559,161
	BENEFIT-COST RATIO	0.14
	NET BENEFITS	($482,131)
		ALT. ZB
BULKHEADS	AVERAGE ANNAUL BENEFITS	**$444,816**
	AVERAGE ANNUAL COSTS	**$401,357**
	BENEFIT-COST RATIO	**1.11**
	NET BENEFITS	**$43,459**
		ALT. ZJ
WAVE BREAKER	AVERAGE ANNUAL BENEFITS	$59,694
	AVERAGE ANNUAL COSTS	$484,486
	BENEFIT-COST RATIO	0.12
	NET BENEFITS	($424,792)

411. CYCLE 3 ALTERNATIVES - ABSECON ISLAND OCEANFRONT. All the remaining alternatives for the oceanfront include beachfill. Therefore, optimization of beachfill design parameters was seen as the first step in the cycle 3 process. Modelling various beachfill configurations provided insight as to the performance of the design parameters. Groin and bulkhead features were evaluated afterwards, based on that insight.

412. The communities of Ventnor, Margate and Longport are considered as one project reach. The three communities are similar both in economics and coastal hydraulics. As shown in Table 35A, there are many similarities which lead to formulating as a distinct reach. Dividing the continuously developed shorefront at the municipal boundaries is viewed as arbitrary. Additionally, performance of the project, in terms of longevity and nourishment requirements, is enhanced by formulating with one reach.

TABLE 35A
RATIONALE FOR CONSIDERING
VENTNOR, MARGATE AND LONGPORT
AS ONE PROJECT REACH

	VENTNOR	**MARGATE**	**LONGPORT**
# of Structures/Mile	137	199	235
Type of Development	Residential	Residential	Residential
Long Term Erosion Rate	0 ft/yr.	0 ft/yr.	0 ft/yr.
Direction of Littoral Transport	southwest	southwest	southwest
Orientation of Shoreline	northeast to southwest	northeast to southwest	northeast to southwest
When Seawall/Bulkhead Fails	100 year event	100 year event	100 year event
Primary Damage Mechanism	wave-inundation	wave-inundation	wave-inundation

413. Design Parameters. In cycle 3, the beach nourishment alternative required optimization of the design parameters. This was accomplished by varying parameters between a set of salient parameters established at the beginning of the analysis. In developing these parmeters the Shore Protection Manual, Coastal Engineering Tech Notes (CETN), the existing conditions in the study area and accepted coastal engineering practice were reviewed. Listed below are the boundary conditions utilized to construct a logical methodology to efficiently identify the optimum plan.

414. Berm Elevation. The natural berm elevation is determined by tides, waves, and beach slope. If the nourished berm is too high, scarping may occur, if too low, ponding and temporary flooding may occur when a ridge forms at the seaward edge. Design berm heights for each alternative have an elevation set at the natural berm crest elevation as determined by historical profiles. The average existing berm elevation in the study area varies between +7.5 and +9.0 feet NGVD. It was determined that a constructable template which closely matches the prevailing natural berm height in the study area is +8.5 ft. NGVD. This elevation was used for all designs.

415. Beachfill Slope. The slope of the design berm is based on historical profiles and the average slope of the berm, both onshore and offshore. The slope of the foreshore slope for all alternatives was set as 30H:1V down to the mean low water elevation. A 30H:1V slope closely matches the

existing slope of the beaches in the study area. Below mean low water the slope follows that of the existing profile to the point where the design berm meets the existing profile.

416. Berm Width. An interval between successive berm widths was chosen for modelling purposes. This interval is set wide enough to discern significant differences in costs and benefits between alternatives but not so great that the NED plan can not be accurately determined. Additionally, due to the capability of the storm modeling methodology, a 50 foot interval was determined to be the most practical. The largest design berm width is based on an analysis of the average existing beach profile and determining how far offshore the design berm could go before the quantities required to construct such a berm clearly increase faster than the additional benefits captured. Based on the cycle 3 analysis, the largest berm width considered was 250 ft. The smallest berm width was determined in a similar manner, by analyzing benefits captured with minimum dimensions. Based on this analysis, the smallest berm width considered was 75 ft. This was also determined to be the minimum practicable to support a small dune.

417. Design Baseline. All berm widths are referenced from a design baseline which was established along the ocean frontage of the project study area in order to determine the alignment of the proposed beach restoration alternatives. In Atlantic City, the design baseline was set as the seaward edge of the existing boardwalk. In the city of Ventnor, the design baseline was also located at the seaward edge of the existing boardwalk up to Richards Avenue. From Richards Avenue south to the end of the boardwalk (which is the southern terminus of Ventnor), the baseline was located ten feet behind the seaward edge of the existing boardwalk. In Margate and Longport, the design baseline was located at the seaward edge of those bulkheads and seawalls which projected the greatest distance seaward. This allowed the design baseline to avoid abrupt shifts in alignment as a result of changes in the location of the seaward edge of the bulkheads. This produces a constructable beachfill template which transitions smoothly along the shoreline.

418. Dune Heights. The lowest design dune height evaluated was sufficiently above the height of the berm and existing protective structures in order to provide for additional storm damage protection, principally in the form of reduced inundation and wave attack damages. Based on bulkhead elevations and the results of the without-project analysis it was estimated that dune heights of +12.5, +14 ft., +16 ft. and +18 ft. NGVD should be considered to capture significant benefits within this study area.

419. Dune Shape. Dune top width for all alternatives was 25' except for those alternatives with a 75' berm width, in which case the dune top width was 15'. This was due to footprint requirements. Side slopes were set at 5H:1V, which was determined to be the optimum condition based on native sand grain size, and the grain size of sand to be obtained from offshore borrow areas.

420. Dune Alignment. The landward toe of the proposed dune system in Atlantic City was offset 25' seaward from the design baseline to align the design with the existing dunes and geotube reinforced dunes. The landward toe of the dune in Ventnor, Margate and Longport was located as close as possible to the design baseline taking into account piers and boardwalks. The landward beach elevation is based on the existing profiles in areas where this condition exists.

421. Design Beachfill Quantities. Quantities for each alternative were calculated by superimposing the proposed design templates on the existing beach survey cross sections. Average end area methods were used to compute the volumes.

422. Nourishment Volumes. In order to maintain as a minimum the design profile, an advanced nourishment or maintenance volume is added to the initial quantity. Without renourishing on a periodic basis, the design profile would begin to erode. Therefore, an advanced nourishment fill is placed in addition to the initial design beachfill. The nourishment volume is considered sacrificial and protects the design beachfill, and at the end of the periodic nourishment cycle, the design profile remains. For cycle 3, the nourishment period was taken to be three years. The final nourishment quantities were increased by an overfill factor of 1.4. Initial design volumes were determined by adding the advanced nourishment volumes and the design volumes obtained from the survey cross sections.

423. Storm Drain Outfalls. At the time of the last structure inventory, most outfalls as noted in the Existing Structures section of this report were intact and in fair to good condition. At the present, the condition of some of these outfalls has degraded. In Atlantic City, all outfalls are intact up to approximately the mean low water line; however, several of the existing outfall pipes have broken off at pipe sections located in the surf zone. The existing length of these outfalls is not adequate to assure unhindered drainage for those proposed beachfill alternatives having a berm width of 200 feet or greater. Therefore, costs to extend these outfalls were included for the corresponding Cycle 3 alternatives. This required extending approximately 270' of 20" diameter ductile iron pipe, and 170' of 24" diameter D.I.P., with timber support systems spaced at 18 feet. 220' of 30" diameter D.I.P., and 150' of 36" diameter D.I.P. will also be extended with timber support systems spaced at 9 feet. Several outfalls in Ventnor, Margate and Longport have also suffered damage, and in some cases have sheared off completely at the bulkhead. Costs to extend these outfalls were also included for the Cycle 3 beachfill alternatives. It was assumed that all outfalls would be replaced with 12" diameter D.I.P., for a total length of 1,650 feet, including timber support systems spaced every 18 feet.

424. Typical Beachfill Sections. Figure 37 shows a typical cycle 3 beachfill alternative superimposed on the corresponding survey cross section of the existing beach.

425. Oceanfront Bulkhead Analysis. The Cycle 2 option of raising bulkheads at street ends in Ventnor, Margate and Longport was eventually dropped for the following reasons. The existing bulkhead line in Ventnor and Margate is a conglomeration of privately installed bulkheads of varying designs and heights, interspersed with municipal structures, principally at the road ends. The present bulkhead system does not provide a continuous level of protection. Ventnor, Margate and Longport have begun raising street end bulkheads as funding allows. Those areas which have not been rehabilitated are considered infrastructure with O&M being the responsibility of the locals. Additionally, since many of the bulkheads are on private lands, rehabilitation would incur real estate costs which would be prohibitive.

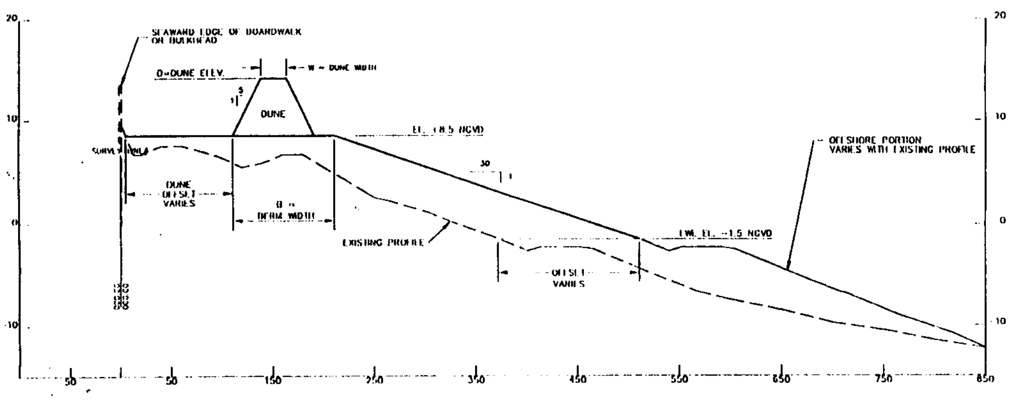
426. Matrix of Oceanfront Design Parameters. Based on the design parameter assumptions discussed above, 25 combinations of berm widths and dune heights was generated. Some berm

and dune alternatives were quickly identified as non-constructable given the footprint requirements of the varying dune options as well as the toe protection required for dune stability. This eliminated six combinations from the matrix.

427. As the modelling proceeded, it became evident that the "no dune" alternatives provided virtually no inundation benefits. Inundation was sensitive to dune height and erosion was sensitive to berm width. To a small degree berm width affected the total storm stage due to the berm's ability to break the waves further offshore. Both dune and berm affected wave attack. Four no-dune alternatives were eliminated from the matrix.

428. The results of the initial model runs indicated that berm widths in excess of 200 ft. resulted in exceptionally higher quantities without a commensurate increase in the performance of reducing the storm impacts. A similar conclusion was reached with dune heights in excess of +16 ft NGVD. Additionally, dune heights greater than 16 ft are so high that they are aesthetically displeasing and block the view of the ocean, even from an elevated the boardwalk. An additional factor in screening out the larger berm widths is that in some cases they extend beyond the historic shoreline and would erode at an accelerated rate. This would greatly increase nourishment requirements, and/or, add costs to modify groins. For these reasons, an additional four alternatives were eliminated from the matrix.

429. As more alternatives were modeled and net benefits calculated, performance trends became evident. These trends helped to identify which alternatives would produce the highest net benefits and thereby optimizing the design. Table 36 summarizes the full matrix of initial alternatives and the final results of the iterative modelling process described above.



ALTERNATIVE	BERM WIDTH B FT.	DUNE WIDTH W FT.	DUNE ELEV. D (FT. NGVD)
A	75	15	12.5
BX	100	25	14
CW	150	-	—
CX	150	25	14
CY	150	25	16
DX	200	25	14
DY	200	25	16
DZ	200	25	18
EY	250	25	16

DEPARTMENT OF THE ARMY
Philadelphia District, Corps of Engineers
Philadelphia, Pennsylvania

NEW JERSEY SHORE PROTECTION STUDY
BRIGANTINE INLET TO GREAT EGG HARBOR INLET
FEASIBILITY STUDY
ABSECON ISLAND STUDY AREA
CYCLE 3 BEACHFILL QUANTITIES
TYPICAL CROSS SECTION

SCALE N.T.S.
SHEET 5 OF 9

Figure 37

TABLE 36
MATRIX OF BEACHFILL ALTERNATIVES

DUNE HEIGHT (FEET NGVD)	BERM WIDTH (FT)				
	75	**100**	**150**	**200**	**250**
Existing	E	E	M	E	E
12.5	M	E	E	E	E
14	X	M	M	M	E
16	X	X	M	M	M
18	X	X	X	M	E

E = Eliminated from optimization by evaluation of the performance trends of the nearest neighbor.
M = Modelled.
X = Inappropriate design template (non-constructable or insufficient footprint).

DETERMINATION OF SELECTED PLAN

430. GENERAL. Costs for both of the oceanfront reaches were developed for the alternative plans discussed above were compared with shore protection benefits to optimize the NED plan in the study area. This was accomplished using the same numerical modeling techniques utilized in the without-project analysis coupled with engineering and technical assessments to interpret model results as applied to the various alternatives. Reduced damages based on the predicted reduction in storm impacts due to the with-project alternatives were compared to the without-project results to generate project benefits. Costs for each alternative were estimated based on standard construction practices and District experience in the construction of beach nourishment projects.

431. STORM IMPACTS. The with-project conditions are the conditions that are expected based on the predicted impacts of storm events on the various project alternatives. The periodic nourishment associated with the project is designed to insure the integrity of the project design. In the case of beachfill this ensures the project design cross section will be maintained and the elimination of shoreline recession due to long-term erosion. However, coastal processes will continue to impact the shoreline along the project area. Storm-induced erosion, wave attack and inundation were evaluated for the with-project conditions using the same methodologies utilized in the without-project analyses. The following sections describe the coastal processes which were used to estimate the with-project damages.

432. Storm Induced Erosion. The numerical model SBEACH was applied to predict storm-induced erosion for the with-project conditions for the study area. All SBEACH input variables were identical to the without-project runs except the input profiles were modified to include the alternative beachfill

designs. As in the without-project condition, storm events from 5 to 500 year frequency were analyzed on the with-project alternatives. Model results were reviewed and analyzed for reasonableness as applied to the varying with-project alternatives. A summary of the with-project erosion results is presented in Appendix A, Section 2.

433. Tables 37 and 38 present the predicted shoreline response for the alternatives which obtained the maximum net benefits for their respective reach. The same reference line used during the without project analysis was used during the with project analysis.

Table 37 - ATLANTIC CITY
Storm Erosion Analysis Predicted Shoreline Erosion Positions
Alternative DY: 200 ft. Berm, 16 ft. Dune

Representative Profile	Erosion Position (ft)[1]						
	5 yr	**10 yr**	**20 yr**	**50 yr**	**100 yr**	**200 yr**	**500 yr**
1[2]	485	495	500	525	530	630	675
2[3]	0	0	0	0	0	400	425
3[4]	30	85	90	100	140	165	180
4[5]	90	100	110	170	200	320	330

Note:
1/ Distances reported are landward erosion limits of the beach profile landward of the Reference Line.
2/ Landward edge of boardwalk located at 720 ft.
3/ Erosion for portions with geotube truncated at 0; landward edge of boardwalk at 360 ft.
4/ Unfailable seawall located at 254 ft.

Table 38 - VENTNOR, MARGATE & LONGPORT
Storm Erosion Analysis Predicted Shoreline Erosion Positions
Alternative BX: 100 ft Berm, 14 ft Dune

Representative Profile	Erosion Position (ft)[1]						
	5 yr	**10 yr**	**20 yr**	**50 yr**	**100 yr**	**200 yr**	**500 yr**
5[2]	90	95	100	110	170	175	175
6[2]	115	155	160	165	170	180	180

Note:
1/ Distances reported are landward erosion limits of the beach profile landward of the Reference Line.
2/ Bulkhead located at 200 ft.

434. Storm Inundation and Wave Attack. The post storm recession profiles generated by SBEACH were used to analyze flooding and wave/run-up attack using the same methodology described in the without-project analyses. The wave height frequency and stage-frequency data utilized to assess the alternative designs was identical to that used for the without-project conditions. Appendix A, Section 2 lists the 3 foot damaging wave/run-up impact zones for the beachfill alternatives within each cell for the 5 through 500 year event as well as the total water elevation profile. Similar inundation profiles were computed for all cells in order to determine the total water level across the beach profile and into the community.

435. ECONOMIC EVALUATION OF ALTERNATIVE PLANS. During Cycle 3, economic benefits derived from the reduction in storm damages were calculated to determine the optimum plan. Once the NED plan has been identified, other benefits are determined. Recreation is not a Federal priority benefit category and is not utilized in the optimization of the selected plan. The benefits leading to project optimization are summarized below and discussed in more detail in the Economic Appendix.

436. Storm Damage Reduction. The beachfill design alternatives will reduce storm damage by reducing profile recession, flooding incurred due to high levels of ocean storm water elevations, and wave run-up and direct wave impacts. Damages were calculated using the same methodologies and databases as previously detailed in the without project conditions. The benefits for any given project are the difference between without project damages and with project damages. The storm damage reduction benefits (including emergency costs) are shown for all Atlantic City alternatives in Table 39.

Table 39

Atlantic City Oceanfront Storm Damage Reduction By Alternative (March 1994 Price Level)						
Alt.	Berm	Dune	Without Project Storm Damages	With Project Storm Damages	Storm Damage Reduction Benefits	Percent Reduced
CW	150	Existing	$5,302,000	$3,271,850	$2,030,150	38%
CX	150	+14	$5,302,000	$1,615,980	$3,686,020	70%
CY	150	+16	$5,302,000	$1,371,860	$3,930,140	74%
DX	200	+14	$5,302,000	$1,522,420	$3,779,580	71%
DY	200	+16	$5,302,000	$1,072,830	$4,229,170	80%
DZ	200	+18	$5,302,000	$958,310	$4,343,690	82%
EY	250	+16	$5,302,000	$912,040	$4,389,960	83%

Note: In order to extrapolate the with project storm damages for the 250 foot berm alternative, it was assumed that: (1) wave-inundation damages for Alt. EY was the same as wave-inundation damages for Alt. DY since the dune height is the same; and (2) erosion damages for Alt. EY were completely eliminated due to the wider berm width.

437. OPTIMIZATION OF ATLANTIC CITY OCEANFRONT. Optimization of the alternatives is based on storm damage reduction which is the priority benefit category. During this analysis of net benefits, figure were adjusted to the October 1995 price level. Initial fill and nourishment costs for the various project alternatives are annualized for comparison to the average annual benefits for a specific project alternative. Recreation and other incidental benefits were not used in the optimization procedure. Initial construction, periodic nourishment, and major rehabilitation costs are annualized over a 50 year project life at 7⅝%. The average annual costs are subtracted from average annual benefits to calculate net benefits and select the optimal plan which maximizes net benefits. Included in Table 40 are the average annual benefits and costs, the net benefits and benefit-cost ratio for storm damage reduction and reduced maintenance benefits. Plan DY with a 200' berm and a dune at +16 NGVD is the optimal plan for Atlantic City.

Table 40

Atlantic City Oceanfront Benefit/Cost Matrix
Average Annual Benefits and Costs for With Project Alternatives
(Oct. 1995 Price Level)

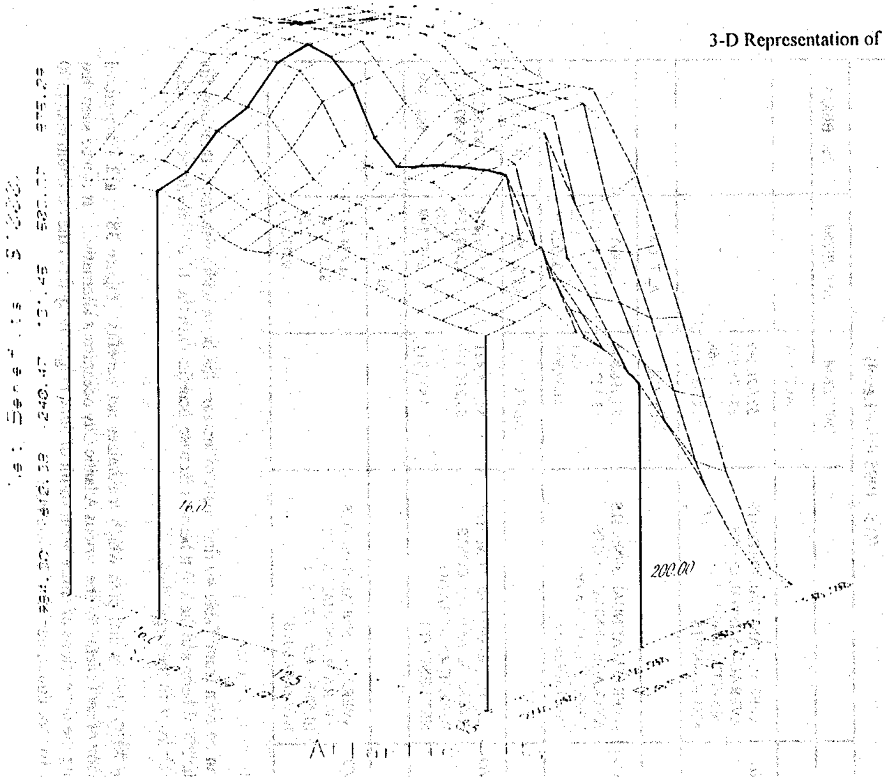
		150' BERM	200' BERM	250' BERM
		ALT. CW		
NO DUNE	AVERAGE ANNUAL BENEFITS	$2,091,249		
	AVERAGE ANNUAL COSTS	$3,075,593		
	BENEFIT-COST RATIO	0.68		
	NET BENEFITS	($984,344)		
		ALT. CX	ALT. DX	
+14' NGVD DUNE HEIGHT	AVERAGE ANNUAL BENEFITS	$3,796,954	$3,893,330	
	AVERAGE ANNUAL COSTS	$3,127,149	$3,301,274	
	BENEFIT-COST RATIO	1.21	1.18	
	NET BENEFITS	$669,806	$592,056	
		ALT. CY	**ALT. DY**	ALT. EY
+16' NGVD DUNE HEIGHT	AVERAGE ANNUAL BENEFITS	$4,048,421	**$4,356,451**	$4,522,078
	AVERAGE ANNUAL COSTS	$3,216,410	**$3,399,153**	$3,873,690
	BENEFIT-COST RATIO	1.26	**1.28**	1.17
	NET BENEFITS	$832,011	**$957,298**	$648,388
			ALT. DZ	
+18' NGVD DUNE HEIGHT	AVERAGE ANNUAL BENEFITS		$4,474,417	
	AVERAGE ANNUAL COSTS		$3,541,844	
	BENEFIT-COST RATIO		1.26	
	NET BENEFITS		$932,573	

438. It can be seen from Table 40 that costs to increase the berm width rise faster than benefits between the 200 ft berm and the 250 ft berm. Likewise, benefits with the 18 ft dune do not outweigh costs associated with the larger dune.

439. The NED plan is that plan which maximizes net benefits. Figure 38 is a 3 dimensional representation of net benefits for the various Atlantic City oceanfront alternatives. It can be seen that by changing the dimensions of either berm width of dune height away from the optimum plan (200 foot berm/16 foot dune), net benefits decrease.

Figure 38

3-D Representation of Net Benefits



440. The beachfill design alternatives for Ventnor, Margate and Longport will reduce storm damage by reducing profile recession, flooding incurred due to high levels of ocean storm water elevations, and wave run-up and direct wave impacts. Damages for the with project alternatives were calculated using the same methodologies and databases as previously detailed in the without project conditions. The benefits for any given project are the difference between without project damages and with project damages. The storm damage reduction benefits (including emergency costs) are shown for all Ventnor, Margate and Longport alternatives in Table 41.

Table 41

Ventnor, Margate, Longport
Storm Damage Reduction By Alternative
(March 1994 Price Level)

Alt.	Berm	Dune	Without Project Storm Damages	With Project Storm Damages	Storm Damage Reduction Benefits	Percent Reduced
AV	75	+12.5	$6,210,000	$2,833,834	$3,376,166	51%
BX	100	+14	$6,210,000	$2,219,820	$3,990,180	61%
CW	150	Existing	$6,210,000	$4,431,060	$1,778,940	25%
CX	150	+14	$6,210,000	$2,157,020	$4,052,980	62%
CY	150	+16	$6,210,000	$1,643,870	$4,566,130	70%
DX	200	+14	$6,210,000	$2,026,430	$4,183,570	64%
DY	200	+16	$6,210,000	$1,542,290	$4,667,710	72%

441. OPTIMIZATION OF VENTNOR, MARGATE AND LONGPORT. Optimization of the alternatives is based on storm damage reduction which is the priority benefit category. During this analysis of net benefits, figure were adjusted to the October 1995 price level. Initial fill and nourishment costs for the various project alternatives are annualized for comparison to the average annual benefits for a specific project alternative. Recreation and other incidental benefits were not used in the optimization procedure. Initial construction, periodic nourishment, and major rehabilitation costs are annualized over a 50 year project life at 7⅝%. The average annual costs are subtracted from average annual benefits to calculate net benefits and select the optimal plan which maximizes net benefits. Included in Table 42 are the average annual benefits and costs, the net benefits and benefit-cost ratio for storm damage reduction and reduced maintenance benefits. Plan BX with a 100' berm and a dune at +14 NGVD is the optimal plan for Ventnor, Margate, Longport.

Table 42

Ventnor, Margate, Longport Benefit/Cost Matrix
Average Annual Benefits and Costs for With Project Alternatives
(Oct. 1995 Price Level)

		75' BERM	100' BERM	150' BERM	200' BERM
				ALT. CW	
NO DUNE	AVERAGE ANNUAL BENEFITS AVERAGE ANNUAL COSTS BENEFIT-COST RATIO NET BENEFITS			$1,832,479 $4,028,980 0.45 ($2,196,501)	
		ALT. AV			
+12.5' NGVD DUNE HEIGHT	AVERAGE ANNUAL BENEFITS AVERAGE ANNUAL COSTS BENEFIT-COST RATIO NET BENEFITS	$3,477,775 $3,271,404 1.06 $206,370			
			ALT. BX	ALT. CX	ALT. DX
+14' NGVD DUNE HEIGHT	AVERAGE ANNUAL BENEFITS AVERAGE ANNUAL COSTS BENEFIT-COST RATIO NET BENEFITS		**$4,110,268** **$3,517,916** **1.17** **$592,352**	$4,174,958 $4,313,241 0.97 ($138,283)	$4,309,478 $4,984,092 0.86 ($674,614)
				ALT. CY	ALT. DY
+16' NGVD DUNE HEIGHT	AVERAGE ANNUAL BENEFITS AVERAGE ANNUAL COSTS BENEFIT-COST RATIO NET BENEFITS			$4,703,552 $4,407,449 1.07 $296,102	$4,808,189 $5,080,370 0.95 ($272,181)

Note: N/A denotes those alternatives which were not appropriate designs (see Table 36).

442. It can be seen from Table 42 that costs to increase the berm width rise faster than benefits between the 100 ft berm and the 150 ft berm. Likewise, the 16 ft dune provides less net benefits than the 14 ft dune.

443. Results of the hydraulic modeling indicated that dune height affects inundation and berm width affects erosion. This is a simplification, but was found to be generally true. Trends which were observed when interpreting the results of the storm damage analyses can be applied to the alternatives in question.

444. <u>12.5 ft dune/100 ft berm</u> - As seen in table 41, benefits increase ten percent from alternative AV

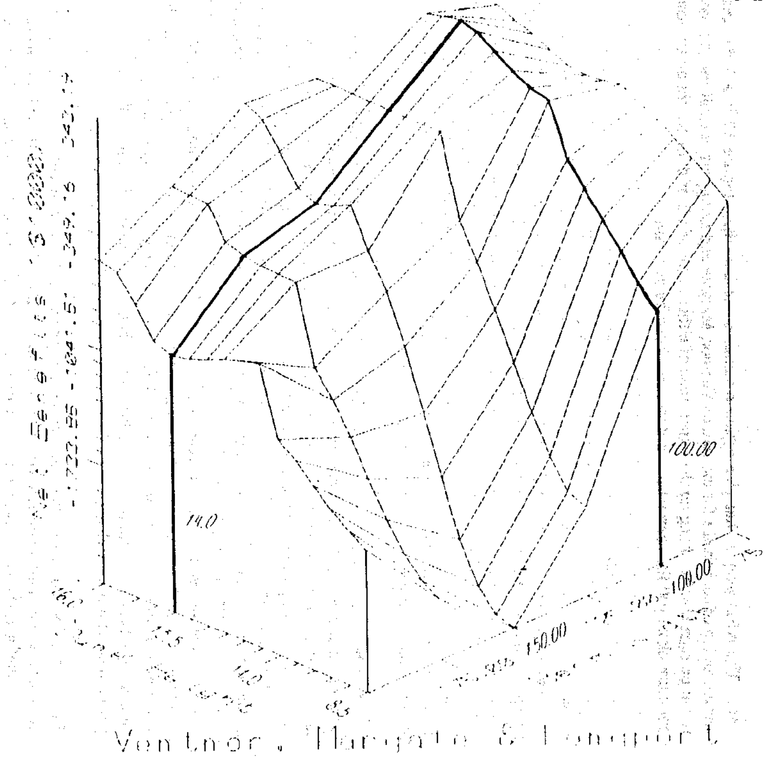
to BX. This increase is due almost solely to the wave-inundation damage mechanism associated with the dune height increase. The increase in berm width from 75 feet to 100 feet had almost no effect on the benefits. At the same time, costs went up only 7.5 percent, resulting in higher net benefits. Therefore it can be surmised that increasing the berm width to 100 ft while not increasing the dune height would result in, virtually the same benefits and higher costs, resulting in less net benefits.

445. 12.5 ft dune/150 ft berm - As seen in table 41, benefits increase only one percent from alternative BX to CX. Of that increase, $67,500 is due to erosion and $61,680 is due to wave-inundation. The increase in berm width from 100 feet to 150 feet had a small overall effect on the benefits. At the same time, costs went up by 23 percent, resulting in greatly reduced net benefits. Therefore it can be surmised that increasing the berm width to 150 ft while not increasing the dune height will result in, virtually the same benefits and much higher costs, resulting in less net benefits.

446. The NED plan is that plan which maximizes net benefits. Figure 39 is a 3 dimensional representation of net benefits for the various Ventnor, Margate and Longport oceanfront alternatives. It can be seen that by changing the dimensions of either berm width of dune height away from the optimum plan (100 foot berm/14 foot dune), net benefits decrease.

Figure 39

3-D Representation of Net Benefits



447. GROIN ANALYSIS. Following the selection of the optimized beachfill alternative, groins were analyzed to determine whether the costs to construct them is offset by the savings due to the reduction in periodic nourishment. Coincident with this effort, periodic nourishment requirements based on past reports and historic shoreline change were compared with the results of GENESIS shoreline evolution modelling.

NUMERICAL MODELLING OF SHORELINE CHANGE

448. GENERAL. In recent years numerical shoreline change models have become an increasingly popular tool for investigating impacts of proposed coastal projects. Specifically, shoreline change models are ideally suited for tasks involving the analysis and evaluation of coastal projects with regard to the long-term fate of beachfills, renourishment cycles and coastal structures designed to enhance the longevity of placed beach fill material. As part of this Feasibility study, a shoreline change model has been developed which may be used for predicting relative future shoreline trends and responses along the Atlantic Ocean coastline of Absecon Island.

449. GENERALIZED MODEL FOR SIMULATING SHORELINE CHANGE (GENESIS). The shoreline change model used in this study is GENESIS, developed by the U.S. Army Corps of Engineers, Coastal Engineering Research Center (Hanson and Kraus, 1989; Gravens, Kraus and Hanson, 1991). The acronym GENESIS stands for GENEralized Model for SImulating Shoreline Change and encompasses a group of programs developed for simulating wave-induced longshore transport and movement of the shoreline. GENESIS was developed to simulate long-term shoreline change on an open coast as produced by spatial and temporal changes in longshore transport (Hanson, 1987, 1989; Hanson and Kraus, 1989). Wave action is the mechanism producing longshore transport. In GENESIS, spatial and temporal differences in the transport rate may be caused by such diverse factors as irregular bottom bathymetry, wave diffraction behind structures, sources and sinks of sand, and structures such as seawalls or groins which constrain the transport.

450. Capabilities and Limitations of GENESIS. GENESIS is designed to describe long-term trends of the beach plan shape change under imposed wave conditions, boundary conditions, and constraints due to coastal structures. GENESIS works best in calculating shoreline response when the change will produce a long-term trend in shoreline movement, as it progresses from one equilibrium state toward another as a result of some significant perturbation. Shoreline change models are not applicable to simulating a randomly fluctuating beach system in which no shoreline movement trend is evident. GENESIS is not applicable to calculating shoreline change in the following situations which involve shoreline change unrelated to spatial differences in wave-induced longshore sand transport: beach change inside inlets or areas dominated by tidal currents, beach change produced by wind-generated currents, storm-induced beach erosion where cross-shore sediment processes dominate the beach evolution process (this type of beach evolution is best modelled using a cross-shore transport model such as SBEACH).

451. GENESIS is based on the one-contour-line beach evolution concept. It is assumed that the beach profile maintains a constant equilibrium profile shape. This implies that the bottom contours are parallel and the entire profile is translated seaward or landward for an accreting or eroding

shoreline, respectively. With this assumption, it is only necessary to consider the movement of one contour line. For this study, the mean high water (MHW) contour was chosen.

452. Input Data Requirements. There are two dominant physical data types that must be assembled for input to GENESIS; shoreline position data and wave data.

453. U.S. Army Corps of Engineers LRP survey lines along the project area were analyzed to determine the average berm height and the depth of closure. These parameters define the vertical limits of the control volume within which longshore sand transport takes place. Multiplying this vertical range by the shoreline length and the shoreline change (advance/retreat) allows the conversion of shoreline change data to volumetric change data. As detailed earlier, GENESIS does not model the offshore profile response, but assumes that the beach profile retains the same shape while moving landward and seaward. However, profile information is needed to determine the location of breaking waves alongshore and depths at the offshore tips of structures, and to calculate an average nearshore bottom slope for use in the longshore transport equation. To develop this profile information, GENESIS requires the "effective grain size" (corresponding to the equilibrium profile) to be input.

454. SIMULATION OF LONG-TERM SHORELINE CHANGE. A sediment budget was developed for the Atlantic Ocean coastline of New Jersey ranging from North Brigantine Island to Ocean City. The sources, sinks and volumetric rates of sand moving into and out of the region were investigated (see earlier section "Brigantine Inlet to Great Egg Harbor Inlet Sediment Budget" for further detail). The objective of the budget study was to account for the gain or loss of sediment through time by a study of the various factors that influence sediment erosion, transportation and deposition in the study area.

455. Development of a Wave Climate. The calibration/verification time period modelled extended from October 7, 1986 to March 6, 1993, based upon the available shoreline position information (see next section). A wave hindcast in 10 meters of water extending from November 1, 1987 to October 31, 1993 was used as a basis for developing the wave climate. The hindcast was based on WIS Station 68 data which had been transformed in from deep water using the SHALWAVE routine, which considers real bathymetry in its computational routine. As the period from October 7, 1986 to October 31, 1987 was lacking from the available hindcast, steps were taken to fill this gap, based on analysis of the hindcast and knowledge of the actual wave conditions during that time. Due to their generally similar mild characteristics, the first three years of data in the hindcast (November 1, 1987 to October 31, 1990) were vector averaged to develop a wave data record to be substituted into the period of November 1, 1986 to October 31, 1987. The portion of the vector averaged record from October 7, 1987 to October 31, 1987 was also substituted into the period of October 7, 1986 to October 31, 1986.

456. GENESIS CALIBRATION AND VERIFICATION STRATEGY. Mean high water shoreline position information from 1986, 1991 and 1993 was available for use in calibration and verification of the GENESIS model. The shoreline data is specified relative to the project baseline. The 1986 shoreline position was taken from the Leatherman shoreline mapping project and occurred in October of that year. The 1991 shoreline position was digitized from aerial photographs taken on March 7th. The 1993 shoreline was taken from planimetric maps of April of that year. As only the 1991 shoreline

had a day of the month specified, and GENESIS requires that a year, month and day be specified, the 1986 and 1993 shorelines were also assumed to occur on the 7th of the month.

457. The GENESIS grid divides the Atlantic Ocean shoreline of Absecon Island into 198 compartments, each measuring 215 feet. The overall grid extends from the Oriental Avenue jetty in Atlantic City to the terminal groin at 11th Street in Longport. In developing the grid, cell dimensions were kept as small as possible to allow for resolution of the extensive groin fields in Atlantic City and Longport, as GENESIS requires two cells between groins to be modelled.

458. The RCPWAVE routine was run on the hindcast wave field to develop height and angle transformation parameters to bring the waves from 10 meter depth to a location landward of significant offshore bathymetry but prior to breaking, in this case 18 feet of water. The RCPWAVE grid covers the same stretch of shoreline as the GENESIS grid, dividing it into 33 compartments, each measuring 1290 feet, for a shoreline resolution of one-sixth that of the GENESIS grid. During model calibration the GENESIS model was run using its internal wave transformation model and using the external RCPWAVE wave transformation model, for comparison of results.

459. Model Calibration. Based upon the dates of the available shoreline position data detailed previously, there was a choice of calibrating the GENESIS model from October 7, 1986 to March 7, 1991, or from March 7, 1991 to April 7, 1993. The latter interval was chosen for two reasons: wave data for the entire period between the two sampled shorelines was available from the original hindcast, and, the two shorelines were measured at the same time of year. Thus the shoreline position data and wave record for the period from March 7, 1991 to April 7, 1993 was used in the calibration effort, and the shoreline position data and wave record for the period from October 7, 1986 to March 7, 1991 was used in the verification effort. The natural shoreline change occurring between March 7, 1991 and April 7, 1993 can be seen in the appendix.

460. Several parameters were varied and tested during the model development, chief among them the permeability of existing coastal structures, wave sheltering angles, wave transformation methods, and the model's internal longshore transport rate scaling variables.

461. Groins are specified in the model by their longshore location as referenced to the GENESIS grid, the distance of their offshore tip from the model baseline, and their permeability, specified as a value between 0.0 and 1.0. An impermeable groin is assigned a value of 0.0, and the model only allows sand to pass over it or around the seaward end. At the opposite end of the spectrum, a groin assigned a permeability of 1.0 is treated by the model as being transparent, and has no effect on longshore transport. It was found that adjusting the value of permeability of one groin could affect large changes in the shoreline evolution in the immediate area of that groin, but that changes over a larger area required several groins in tandem to be set to one of the extremes of the permeability range. This is obviously not the case in nature due to the wide variety of construction types and conditions detailed in the structure inventory. As GENESIS does not take into account the inlet processes which occur at both ends of the study area, and the groin fields are located at the ends of the study area, it was decided to determine which "k" values produced the best shoreline agreement in the interior areas of the island (Ventnor and Margate) and then adjust groin permeabilities to replicate the shoreline at the ends of the study area. Also during model development, wave sheltering

was investigated, as any possible effects due to the ebb shoal on the Brigantine side of Absecon Inlet were not accounted for in the wave hindcast. Lastly, the GENESIS model was run using its internal wave transformation model, and using the external RCPWAVE wave transformation model.

462. During the model development trials, it was found that using the external RCPWAVE wave transformation model resulted in better shoreline reproduction and estimates of longshore transport. RCPWAVE was used in the trial which was selected to represent the calibrated model. The calibrated model produced an average longshore transport rate of 1,200,000 cy/yr (Figure 40), which is approximately an order of magnitude higher than previous predictions. SEDTRAN, a subroutine which computes the potential longshore sand transport rate for a wave record, was run on the hindcast wave record and indicated an average transport rate of 560,000 cy/yr over the record length. That the average transport rate for the entire record is several times greater than previous predictions, and the average transport rate for the calibrated model is an order of magnitude higher than previous predictions, is due to the amount of storm activity present in the wave record, specifically in the calibration time period of March 7, 1991 to April 7, 1993. The beginning years of the hindcast wave record describe mild conditions, and reveal below average transport rates, as detailed in the next section. The investigation of wave sheltering resulted in waves approaching from an angle of greater than 50 degrees being sheltered in the calibrated model. (An observer on the shore, facing seaward, would consider a wave approaching from the left to be a 90 degree wave, and a wave approaching from the right to be a -90 degree wave.) Sheltering waves above the 50 degree mark eliminates approximately 7 percent of the energy of wave spectrum.

463. During model development, the Ocean One shopping mall pier in Atlantic City and the Ventnor fishing pier were added to the model as permeable groins based upon results of model trials and inspection of the naturally occurring shorelines and bathymetry. The model had trouble replicating conditions in the Atlantic City groin field, particularly in the area between Steel Pier and the Ocean One shopping mall pier. This may be due to the magnitude of the natural variations which occur naturally throughout the groin field. All model trials showed excessive erosion just updrift of GENESIS cell 115 (approximately 0.5 miles south of Ventnor fishing pier) and excessive accretion just downdrift. Indeed, this is the only area where the model results differ significantly from nature in Ventnor and Margate in the calibrated model. As this phenomenon is not witnessed in the naturally evolving shorelines, it may be due to the model's requirement that the entire project area's shoreline orientation be specified by one angle in the development of the wave record. This requirement introduces error into the modelling, as the shoreline of Absecon Island is generally concave. In addition, GENESIS cell 115 may be considered the point of curvature of the island, which may be causing the unnatural shoreline evolution in this area. The difference between the GENESIS predicted April 7, 1993 shoreline, and the measured April 7, 1993 shoreline is shown in the appendix.

464. Model Verification. The shoreline position data and wave record for the period from October 7, 1986 to March 7, 1991 were used to verify the calibrated model described above. The natural shoreline change occurring between October 7, 1986 and March 7, 1991 can be seen in Figure 41. The only difference in the model formulation was that the 250,000 cy of fill added to the Longport beach face between 11th and 25th Streets in June 1990 was input to the GENESIS model as a source of sand.

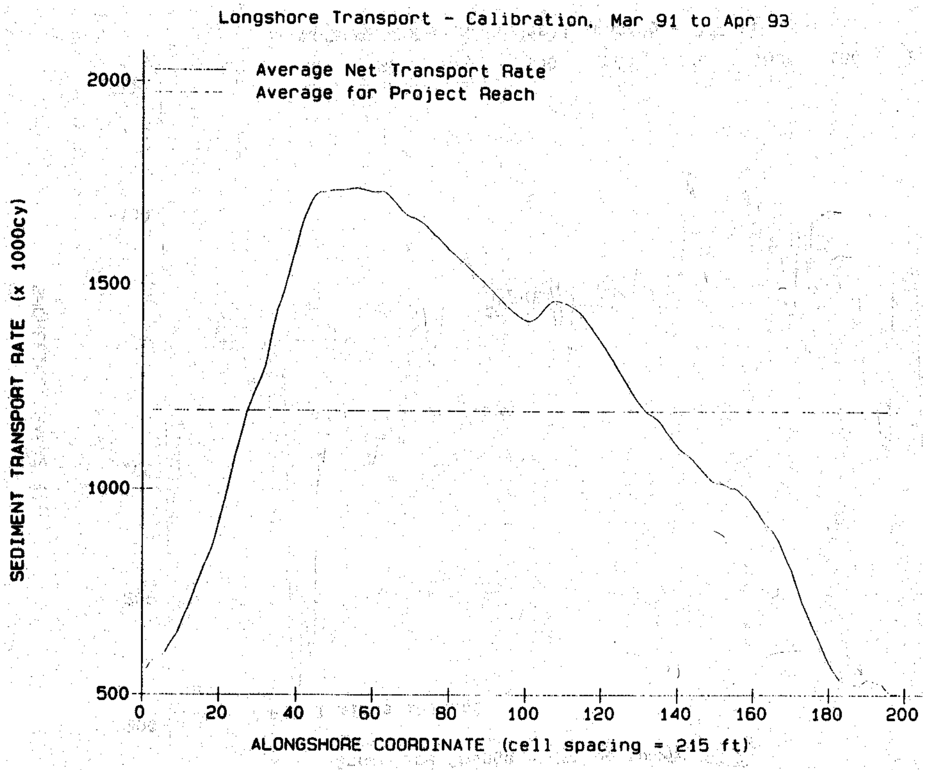
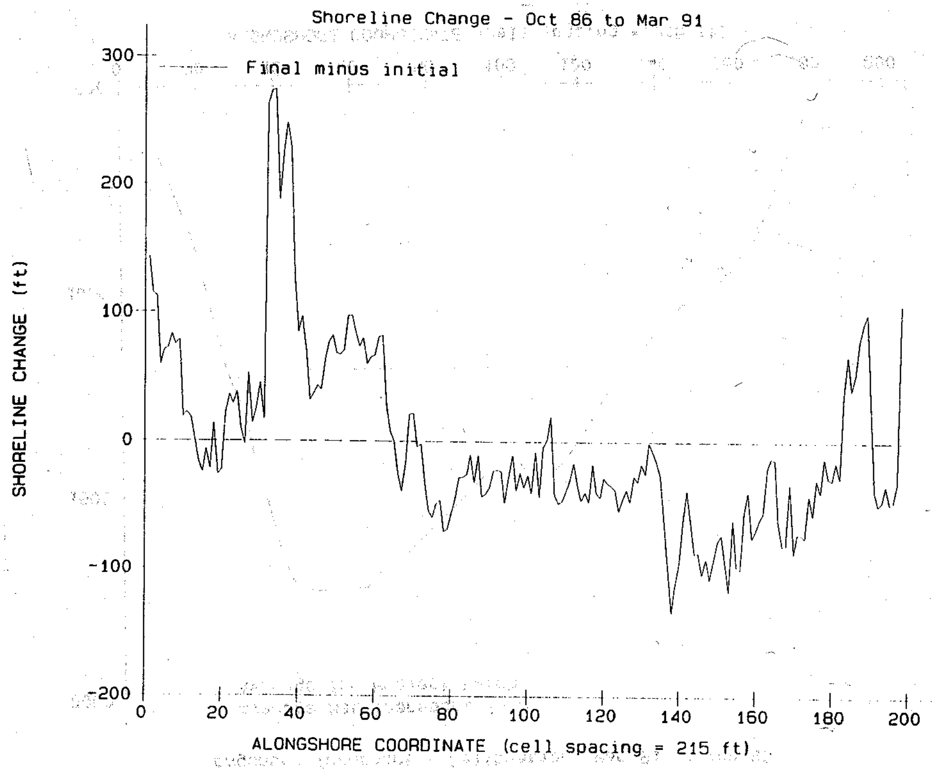

Longshore Transport - Calibration, Mar 91 to Apr 93
Average Net Transport Rate
Average for Project Reach
SEDIMENT TRANSPORT RATE (x 1000cy)
2000
1500
1000
500
0
20
40
60
80
100
120
140
160
180
200
ALONGSHORE COORDINATE (cell spacing = 215 ft)

Figure 40



Shoreline Change - Oct 86 to Mar 91
Final minus initial
SHORELINE CHANGE (ft)
300
200
100
0
-100
-200
0
20
40
60
80
100
120
140
160
180
200
ALONGSHORE COORDINATE (cell spacing = 215 ft)

Figure 41

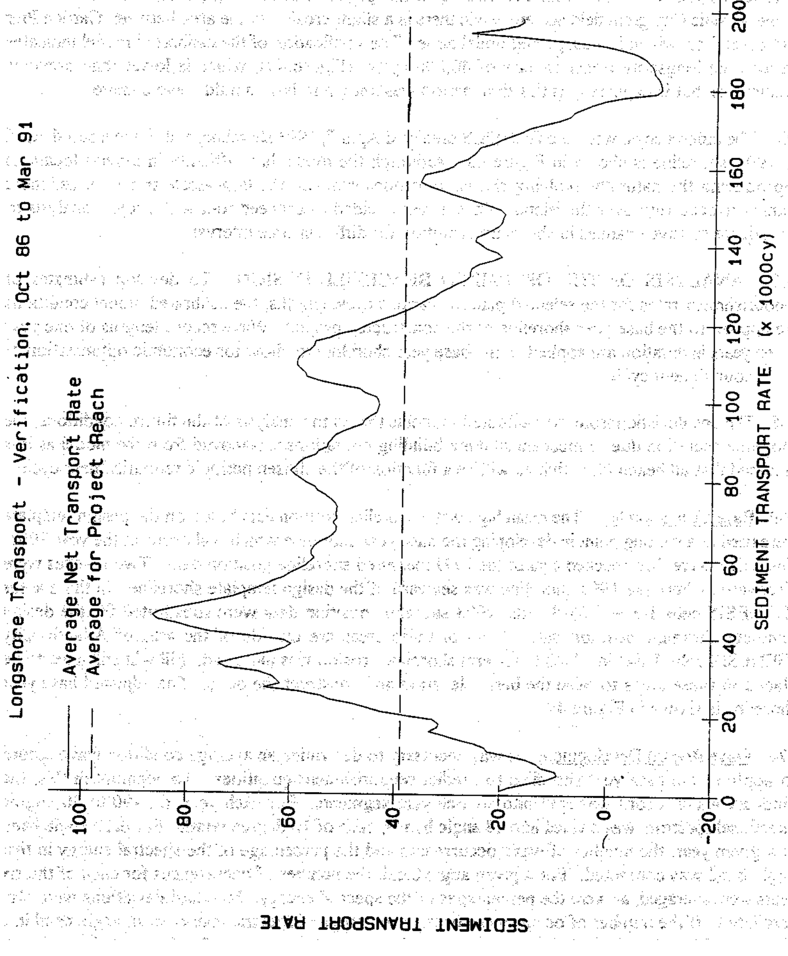

Longshore Transport - Verification, Oct 86 to Mar 91
Average Net Transport Rate
Average for Project Reach
SEDIMENT TRANSPORT RATE
100
80
60
40
20
0
-20
0
20
40
60
80
100
120
140
160
180
200
SEDIMENT TRANSPORT RATE (x 1000cy)

Figure 42

465. The verification time period takes place immediately after the 1,000,000 cy fill in Atlantic City in 1986. As the natural shoreline evolution over this period shows, the southern and northern ends of the Atlantic City groin field accrete, while there is a slight erosion in the area between Garden Pier and Steel Pier, which is a suspected nodal zone. The verification of the calibrated model indicates an average longshore transport rate of 40,000 cy/yr (Figure 42), which is lower than previous predictions, but is expected, as this time period was known to have a mild wave climate.

466. The difference between the GENESIS predicted April 7, 1993 shoreline, and the measured April 7, 1993 shoreline is shown in Figure 43. Although the model has difficulty in several locations reproducing the naturally evolving shoreline, it does simulate the large-scale trends of sediment transport occurring over the island. Thus it was decided to proceed to a with project analysis to investigate relative changes in shoreline evolution for different time intervals.

467. ANALYSIS OF THE OPTIMIZED BEACHFILL DESIGN. To develop estimates of renourishment rates for the selected plan for various cycle lengths, the calibrated model conditions are applied to the base year shoreline of the constructed project. Wave record lengths of one year to ten years in duration are applied to the base year shoreline to allow for economic optimization of the renourishment cycle.

468. The one deviation from the calibrated model is that in the analysis of the future conditions, the shoreline accretion due to mechanical dune-building operations is removed from the model as it is assumed that all beach fill activities will be a function of the chosen periodic renourishment cycle.

469. Base Year Shoreline. The mean high water shoreline position data based on the design template were used as a starting point in developing the base year shoreline which will occur in the year 2001. These data were then checked against the 1993 measured shoreline position data. Two reaches were discovered where the 1993 shoreline was seaward of the design template shoreline. In these areas (GENESIS cells 1-3 and 68-87) the 1993 shoreline position data were substituted for the design template shoreline position data. Both of these areas are outside of the area of Atlantic City (GENESIS cells 8-64) in which long-term shoreline erosion was indicated. Fill will still need to be placed in these areas to raise the berm elevation and construct the dune. The adjusted base year shoreline is shown in Figure 44.

470. Wave Record Development. It was necessary to determine an average condition wave record to apply to the base year shoreline to predict renourishment quantities. To accomplish this, the hindcast wave record was split into six one-year segments. For each year, the -90 to 90 degree directional spectrum was divided into 18 angle bands, each of 10 degree width. For each angle band in a given year, the number of wave occurrences and the percentage of the spectral energy in that angle band was computed. For a given angle band, the number of occurrences for each of the six years were averaged, as were the percentages of the spectral energy. Standard deviations were also computed. If the number of occurrences or the percentage of spectral energy in an angle band in a given year fell within plus or minus one standard deviation of the average for that angle band, it was considered a hit. Values outside of a one standard deviation range of the average were considered to be a miss. The number of hits for each year was then totalled, with the year containing the most hits being considered as the most representative year of the wave record.

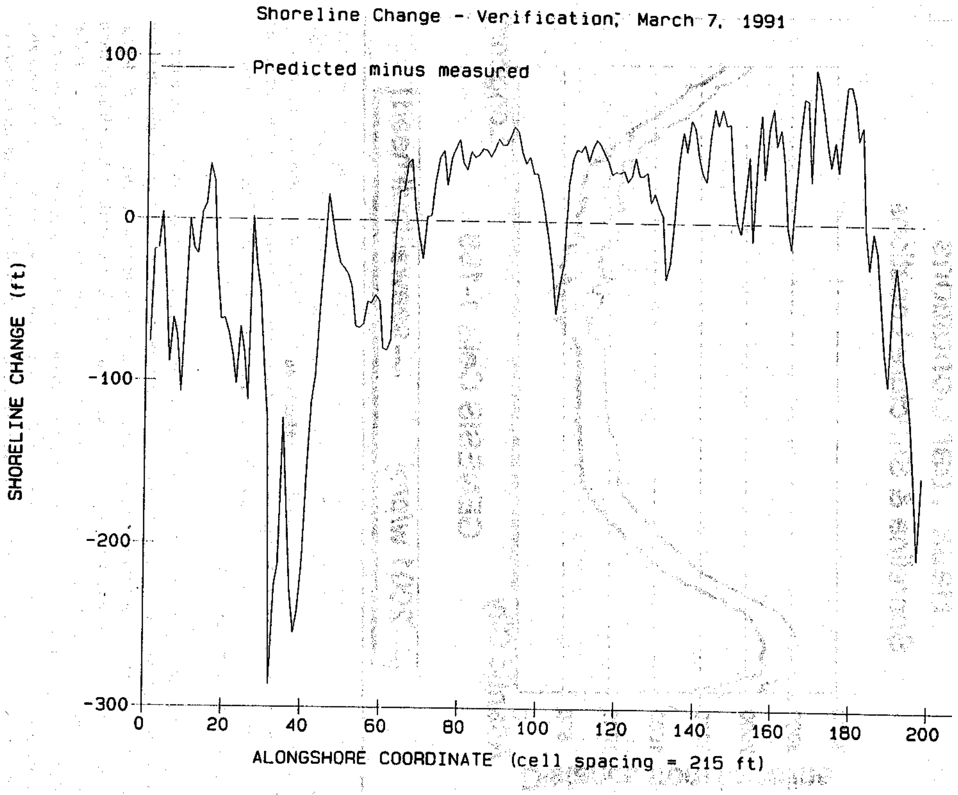

Shoreline Change - Verification, March 7, 1991
Predicted minus measured
SHORELINE CHANGE (ft)
100
0
-100
-200
-300
0
20
40
60
80
100
120
140
160
180
200
ALONGSHORE COORDINATE (cell spacing = 215 ft)

Figure 43

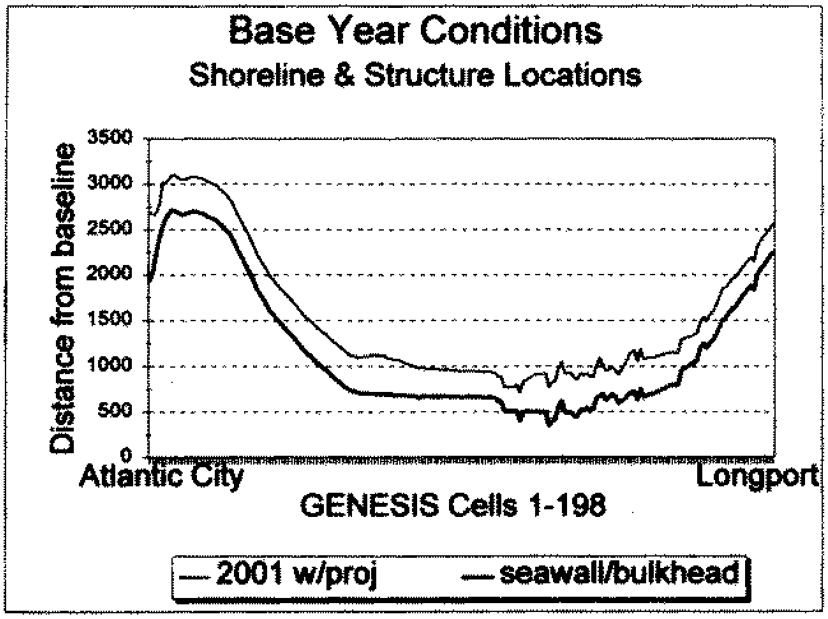

Base Year Conditions
Shoreline & Structure Locations
Distance from baseline
3500
3000
2500
2000
1500
1000
500
0
Atlantic City
Longport
GENESIS Cells 1-198
2001 w/proj
seawall/bulkhead

Figure 44

471. From this analysis it was determined that the second year of the hindcast wave record, November 1, 1988 to October 31, 1989, was the most representative year of the six year hindcast. Thus in the with project analysis, this year's wave record was appended, end-to-end, as many as ten times to manufacture the desired lengths of wave record to be applied to the base year shoreline conditions.

472. Model Output. As the shorelines generated by the model are prone to local spikes, it was decided to first analyze the model predictions as a function of the cumulative volumetric change within each municipality's incorporated boundary. Table 43 shows that Atlantic City and Longport eroded each year, and Ventnor and Margate accreted each year. Logically, the accretion in Ventnor and Margate cannot continue indefinitely. Possible explanations of this phenomenon are: the accretion may stop or reverse if wave records of longer than ten years duration were applied to the base year conditions; representing a long period by repeating a one year representative wave record does not account for the variability of wave climates seen in nature; and one possible sink, offshore loss, is not represented by the model. If these numbers were to be used to recommend a renourishment cycle, only the losses in Atlantic City and Longport should be considered. The amount of fill needed to renourish the Atlantic City and Longport shorelines should not be reduced by the amount of accretion occurring in Ventnor and Margate. However, the values reported by the model based on the predicted shoreline were roughly 15 to 20% of the historical estimates of renourishment requirements (Table 43).

473. When the model predicted shorelines are examined on a cell by cell basis, it is seen that each municipality has areas of erosion and areas of accretion. Thus, it was deemed as too broad a generalization to state that Ventnor and Margate continually accrete and do not require renourishment. Investigating the minimum (farthest landward retreat) shoreline computed by GENESIS allows a more conservative view of the model output. In this scenario, shown in Table 44, the predicted volumetric changes within municipal boundaries are in much better agreement with the historical predictions.

474. GROINS. Additional groins were added to the base year model to investigate if their sand trapping capability could reduce the required renourishment rates sufficiently to offset their cost. The area to the south of the existing Atlantic City groin field was the site of this investigation, due to the impact of the existing groins and local changes in shoreline orientation. In an attempt to smooth and stabilize the shoreline in this area, 100 feet was removed from the seaward end of the groin at Martin Luther King Boulevard (GENESIS cell 32), and four groins were added to the south: Ohio Avenue (GENESIS cell 35) extending 300 feet seaward of the MHW shoreline, Georgia Avenue (GENESIS cell 43) extending 200 feet seaward of the MHW shoreline, Texas Avenue (GENESIS cell) extending 100 feet seaward of the MHW shoreline, and Brighton Avenue (GENESIS cell 52) also extending 100 feet seaward of the MHW shoreline.

475. The model results indicate that any benefit due to the amount of sand trapped by the groins will be offset due to a roughly equal amount of starvation occurring immediately downdrift of the groin field. The presence of the additional groins does not appreciably affect change in the renourishment rate predictions outside of Atlantic City. Table 45 compares the Atlantic City renourishment rate predictions for the with project scenario with and without the additional groins. The permeability

Absecon Island Volumetric Change
Predicted vs. Historical Rates
(cubic yards)

Cycle	Atlantic City	Ventnor	Margate	Longport	TOTAL	HISTORICAL
1 year	-25,000	15,000	20,000	-25,000	50,000	400,000
2 year	-40,000	45,000	30,000	-75,000	125,000	800,000
3 year	-55,000	65,000	40,000	-130,000	185,000	1,200,000
4 year	-70,000	85,000	55,000	-185,000	255,000	1,600,000
5 year	-85,000	100,000	75,000	-245,000	330,000	2,000,000
6 year	-100,000	110,000	100,000	-310,000	410,000	2,400,000
7 year	-115,000	125,000	120,000	-375,000	490,000	2,800,000
8 year	-125,000	135,000	145,000	-430,000	555,000	3,200,000
9 year	-145,000	145,000	170,000	-485,000	630,000	3,600,000
10 year	-160,000	160,000	200,000	-535,000	695,000	4,000,000

"Total" refers to the volume of sand lost from the Atlantic Ocean coastline of Atlantic City and Longport

"Historical" refers to the historical estimate based on long-term erosion, storms and sea-level rise for the Atlantic Ocean coastline of Absecon Island

Table 43

Absecon Island Volumetric Change
Based on Landward-most Shoreline Retreat
Predicted vs. Historical Rates
(cubic yards)

Cycle	Atlantic City	Ventnor	Margate	Longport	TOTAL	HISTORICAL
1 year	-255,000	-135,000	-255,000	-185,000	830,000	400,000
2 year	-330,000	-160,000	-270,000	-265,000	1,025,000	800,000
3 year	-390,000	-170,000	-275,000	-355,000	1,190,000	1,200,000
4 year	-445,000	-180,000	-280,000	-445,000	1,350,000	1,600,000
5 year	-490,000	-185,000	-280,000	-540,000	1,495,000	2,000,000
6 year	-540,000	-190,000	-280,000	-640,000	1,650,000	2,400,000
7 year	-585,000	-190,000	-280,000	-730,000	1,785,000	2,800,000
8 year	-635,000	-190,000	-280,000	-810,000	1,915,000	3,200,000
9 year	-680,000	-190,000	-280,000	-885,000	2,035,000	3,600,000
10 year	-725,000	-190,000	-280,000	-950,000	2,145,000	4,000,000

"Total" refers to the volume of sand lost from the Atlantic Ocean coastline of all four municipalities

"Historical" refers to the historical estimate based on long-term erosion, storms and sea-level rise for the Atlantic Ocean coastline of Absecon Island

Table 44

ATLANTIC CITY NOURISHMENT REQUIREMENTS WITH AND WITHOUT ADDITIONAL GROINS

Cycle	w/o Groins	w/ Groins	Volume Saved
1 year	260,000	270,000	(10,000)
2 year	330,000	350,000	(20,000)
3 year	390,000	400,000	(10,000)
4 year	440,000	450,000	(10,000)
5 year	490,000	490,000	0
6 year	540,000	520,000	20,000
7 year	590,000	560,000	30,000
8 year	630,000	590,000	40,000
9 year	680,000	620,000	60,000
10 year	730,000	650,000	80,000

Table 45

value assigned to the new groins was consistent with values assigned to existing groins in the calibrated model. As newly constructed groins may be less permeable, a lower permeability value was assigned to the new groins, and the model was run again. The increased amount of sand trapped by the groins was offset by an increased amount of starvation downstream of the groin field, thus it was concluded that new groin construction for the purpose of lowering the required renourishment rates was not economically justified.

476. RENOURISHMENT RATES. As the duration of the renourishment cycle is increased, the incremental quantity required as predicted by the model lessens. In addition, as the total quantity increases, the unit price decreases. Thus the annualized cost of the fill material continually decreases as the renourishment interval is increased. Also, with the increase in the duration of the renourishment cycle comes a corresponding decrease in the annualized cost of dredge mobilization and demobilization. The annualized cost of the engineering and surveying work required for the renourishment operation also decreases as the renourishment interval is increased. With all of the costs associated with renourishment operations decreasing as the renourishment interval is increased, economic optimization will occur at the longest interval for which data is provided, in this case a ten year interval.

477. However, this economic analysis does not take into account the risk of a large storm occurring during the interval between renourishment operations nor the risk of higher energy year (one outside the envelope of represented by the sample wave record) occurring. These risks grow with every year the renourishment cycle is increased. This method of analysis will yield a result based upon the largest storm which occurred during the wave record used. However, there is a certain annual probability of occurrence of all storms larger than the lowest frequency storm contained within the wave record. Each year's predicted renourishment rate should not be viewed as a single number, but as an envelope containing a specified percentage of all possible shorelines. At the present time, there is no generally accepted method to quantify this risk and apply it to the economic analysis, but common sense dictates that the increase in this risk would diminish returns as the renourishment cycle is lengthened.

478. Sorensen, Weggel and Douglass (1989) studied the most recent Atlantic City beach fill in 1986 and Everts et al. (1974) studied the 1963 and 1970 fills. Everts et al. (1974) concluded that most sand is lost to the offshore region during the period from September through March, thus placing the fill material in the spring will maximize its residence time on the beach face. Everts et al. (1974) also found that the rate of loss of fill material is proportional to the quantity placed at one time, and thus recommend placing smaller volumes on a more frequent basis to maximize overall residence time. Sorensen, Weggel and Douglass (1989) also recommended frequent placement of small volumes, with the renourishment cycle in the two to four year range.

479. Thus, based on model results, historical predictions, and past experiences in Atlantic City and elsewhere, a three year renourishment cycle, with a total quantity of 1,190,000 cy for the Absecon Island shoreline is recommended. Further, it is recommended that the fill be placed in the spring to maximize residence time.

480. GROIN FIELD. Reduced nourishment rates within Atlantic City due to the proposed groin

field are shown in table 45. If this groin field were built in Atlantic City as part of the selected plan, the annualized cost would be $335,003, while there would be no savings (benefits) in reduced periodic nourishment. Therefore, the placement of a groin field in combination with Plan DY at Atlantic City is not justified. Similarly, the groin field option proposed in Cycle 2 for Longport is also not justified.

481. EXTENSION OF THE LONGPORT TERMINAL GROIN. The remaining groin option from the cycle 2 analysis was the extension of the Longport terminal groin as a way to decrease end losses at the southern terminus of the project. This option must be looked at in relationship to the borrow areas, other projects in the vicinity and potential downdrift impacts.

482. Design Constraints. The outer end of a groin designed to protect a beachfill should be placed where the designed beach slope intersects the existing bottom. Groins placed at the southern terminus of New Jersey's barrier islands are known to trap sediment to such a degree that starvation of the downdrift beach can occur. Also, groins that extend seaward of the breaker zone may force sand to flow too far offshore to be returned to the downdrift beaches, or in this case, the Great Egg Harbor Inlet ebb shoal.

483. Extending the Longport terminal groin would likely impact the sediment budget in Great Egg Harbor Inlet and therefore impact both the Longport borrow area identified in this study and the borrow area currently being used for the Peck Beach/Ocean City Federal project.

484. Longport Borrow area Considerations. During all three time periods analyzed in the sediment budget, the Great Egg Harbor Inlet control volume experienced shoal growth of varying rates. During the period from 1986 to 1993, growth of the Great Egg Harbor Inlet shoals was approximately 200,000 cy/yr. A combination of extending the Longport terminal groin and borrowing from the Longport borrow area would produce a range of negative impacts which would likely exceed any possible benefits of reduced nourishment quantities.

485. CYCLE 3 SUMMARY. Tables 35, 40 and 42 identify the optimized plans for the study area. Included in these tables are the average annual benefits and costs, the net benefits and benefit-cost ratio for storm damage reduction. Plan DY, which provides a 200 ft. berm and a dune with an elevation of +16 ft. NGVD is the optimal design in Atlantic City, while the optimal beachfill design in Ventnor, Margate & Longport is Plan BX which provides a berm width of 100 ft. and dune with an elevation of +14 ft NGVD. The bulkhead design was the optimum plan for the inlet frontage of Atlantic City.

486. The optimized plans are futher detailed in the following Selected Plan chapter.

SELECTED PLAN

IDENTIFICATION OF THE NED PLAN

487. The National Economic Development (NED) Plan is defined as that plan which maximizes beneficial contributions to the Nation while meeting planning objectives. Most of the beachfill plans considered meet the planning objectives in that they provide a degree of storm damage protection which is greater than the cost of implementation. The NED plan for the oceanfront of Atlantic City is beachfill with a berm width of 200 ft. and a dune with an elevation of +16 ft NGVD and for Ventnor, Margate and Longport the NED plan is beachfill with a 100 ft. berm width and dune with an elevation of +14 ft NGVD. The NED plan for the inlet frontage of Atlantic City is to construct two bulkheads which tie into the existing structure. These plans were chosen because they provided the maximum net storm damage reduction benefits.

488. The proposed project does not include fill on privately owned shores or on lands behind erosion control lines.

489. DESCRIPTION OF THE SELECTED PLAN. The design of the selected plan is complete and is consistent with Corps criteria as described in the Shore Protection Manual, CETNs and accepted engineering practice. Additional design work (ie. a Design Memorandum) is not needed with the exception of geotechnical sampling which can be completed concurrent with the development of plans and specifications. The following section describes the selected plan for the study area.

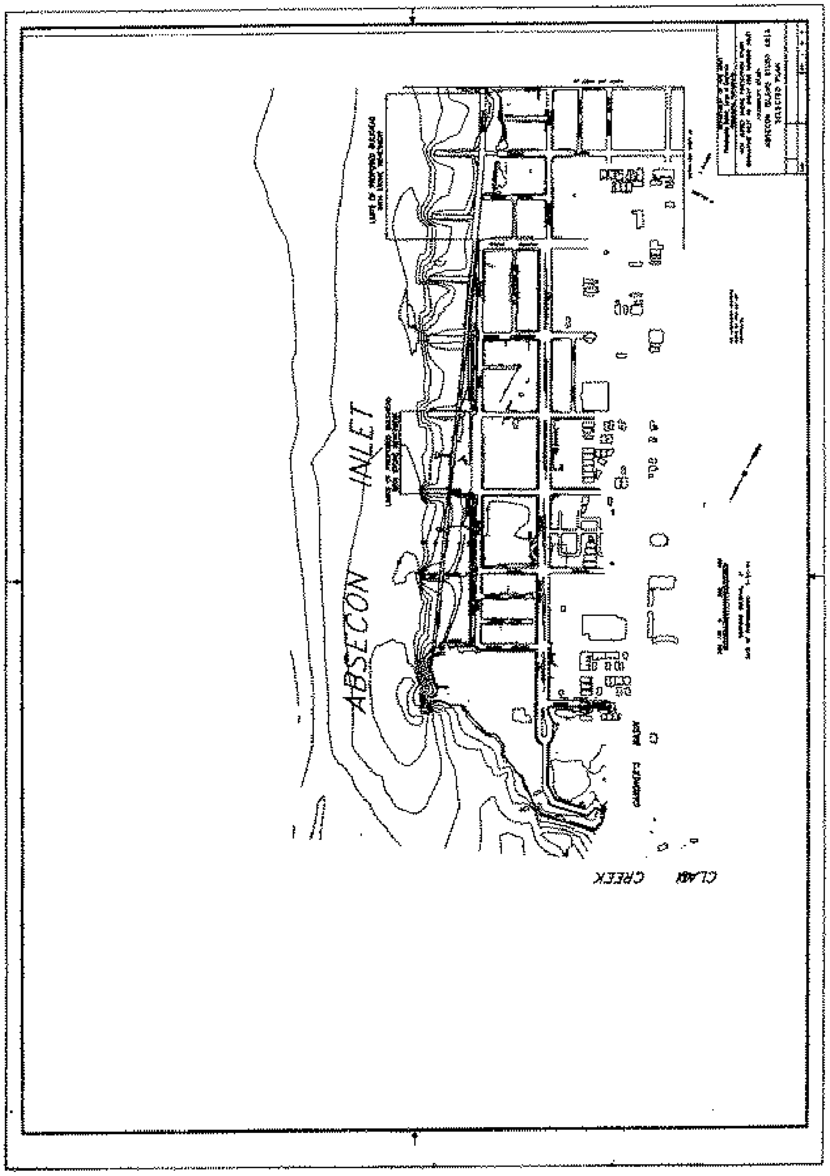
490. Absecon Island Oceanfront. The selected plan for the Absecon Island ocean frontage is a beachfill restoration. In Atlantic City, the beachfill will consist of a 200' wide berm with a top elevation of +8.5 NGVD. A dune with a top elevation of +16 NGVD, top width of 25', and side slopes of 1V:5H will also be constructed, with the landward toe of the dune located 25' seaward of the seaward edge of the boardwalk. In Ventnor, Margate, and Longport the beachfill will have a 100' wide berm with a top elevation of +8.5 NGVD. Dunes will also be constructed to a top elevation of +14 NGVD, with a 25' top width, and side slopes of 1V:5H. The initial beachfill for the entire study area oceanfront will require a total volume of 6,174,013 cy of sand placed over a total length of 42,825 linear feet. The fill volume includes initial design fill requirements plus advanced nourishment. Periodic nourishment of 1,666,000 cy would be placed every 3 years. The beachfill will be transitioned from a 200' berm to a 100' berm between Atlantic City and Ventnor over a distance of 1000'.

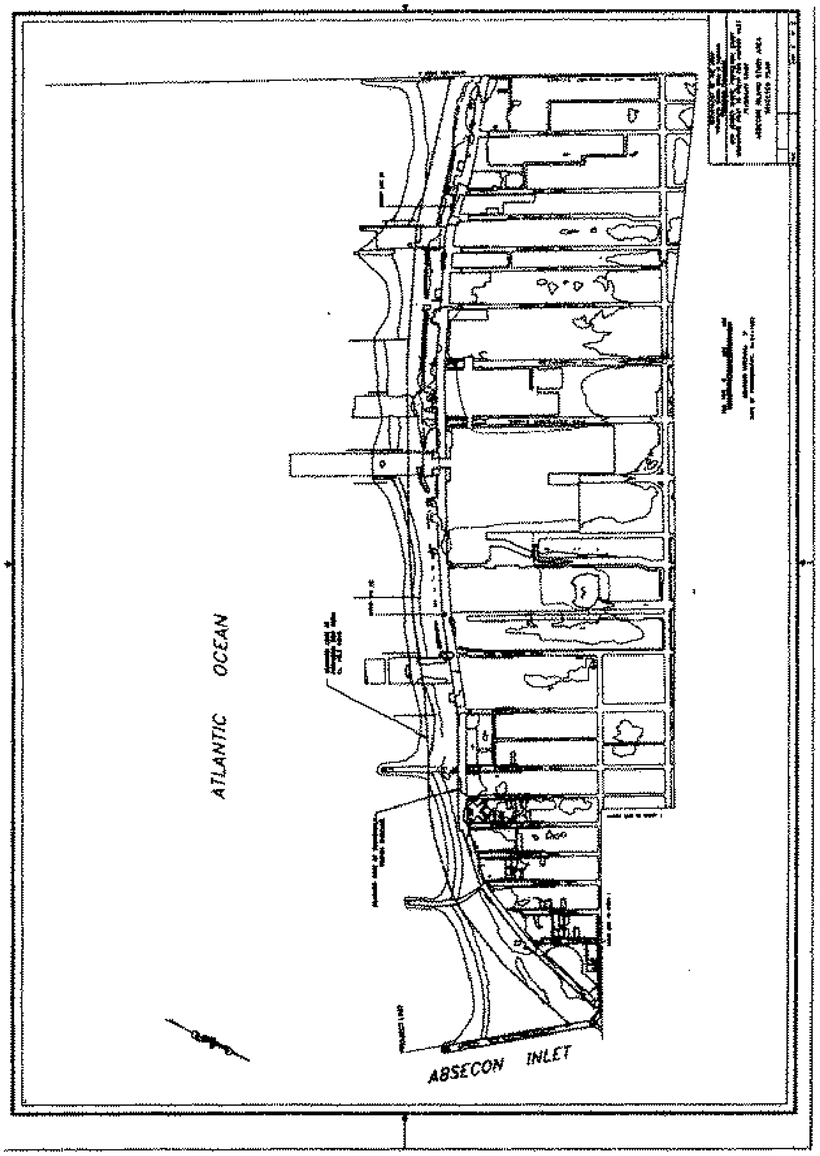
491. Beach Access. The beach access strategy includes natural beach walkover paths, up and over the dunes at a skewed angle and delineated by sand fencing. The sponsor is responsible for maintaining the access ways by replacing fencing as needed, and providing additional sand fill if the access way degrades upon the design dimensions of the dune template. These walkovers would be strategically placed at most street ends or other traffic areas. The final location and dimensions of these walkovers and access ways will be coordinated with the sponsor and local communities during the preparation of plans and specifications. These walkover paths are in addition to any existing structural walkover features currently in place.

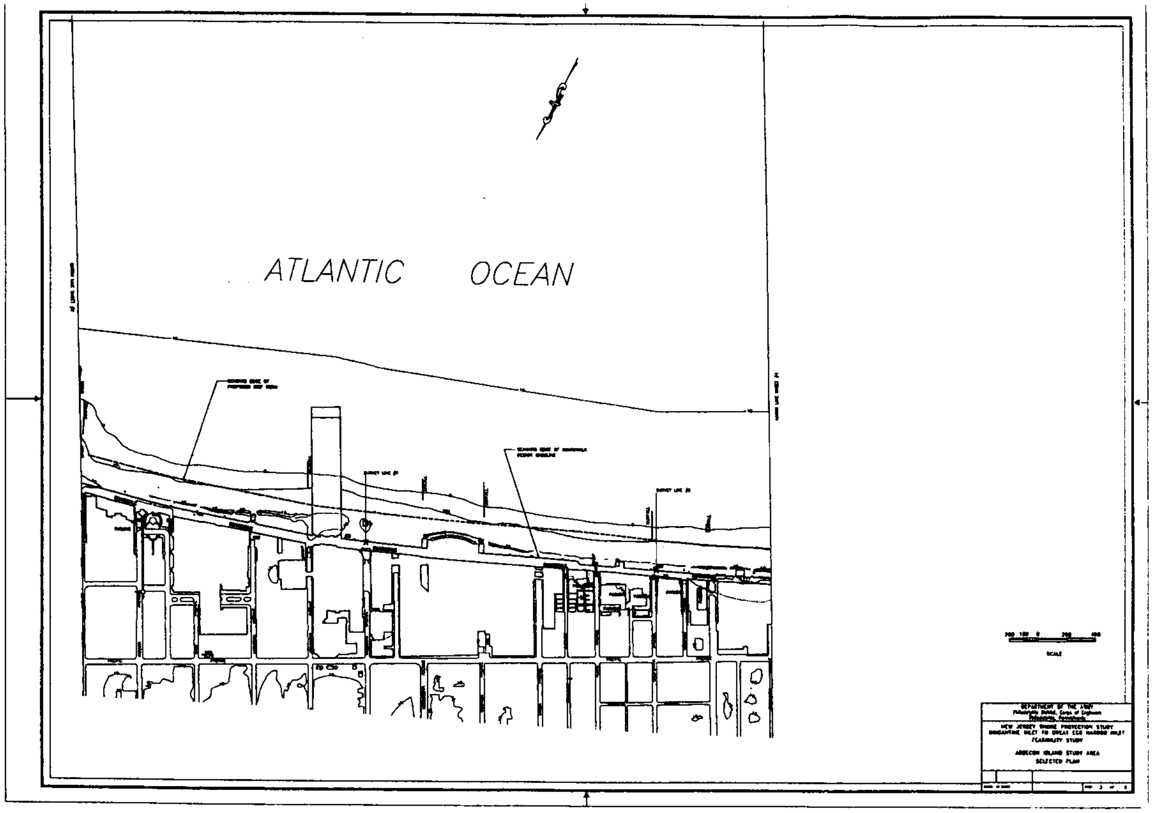
492. Vehicular access will be afforded at existing vehicular access points. These areas will be strengthened by rollup articulated pressure treated timber matting. These areas will also provide handicapped access as well. The final location and number of vehicular and or handicapped access points will be further coordinated with the communities during the development of plans and specifications.

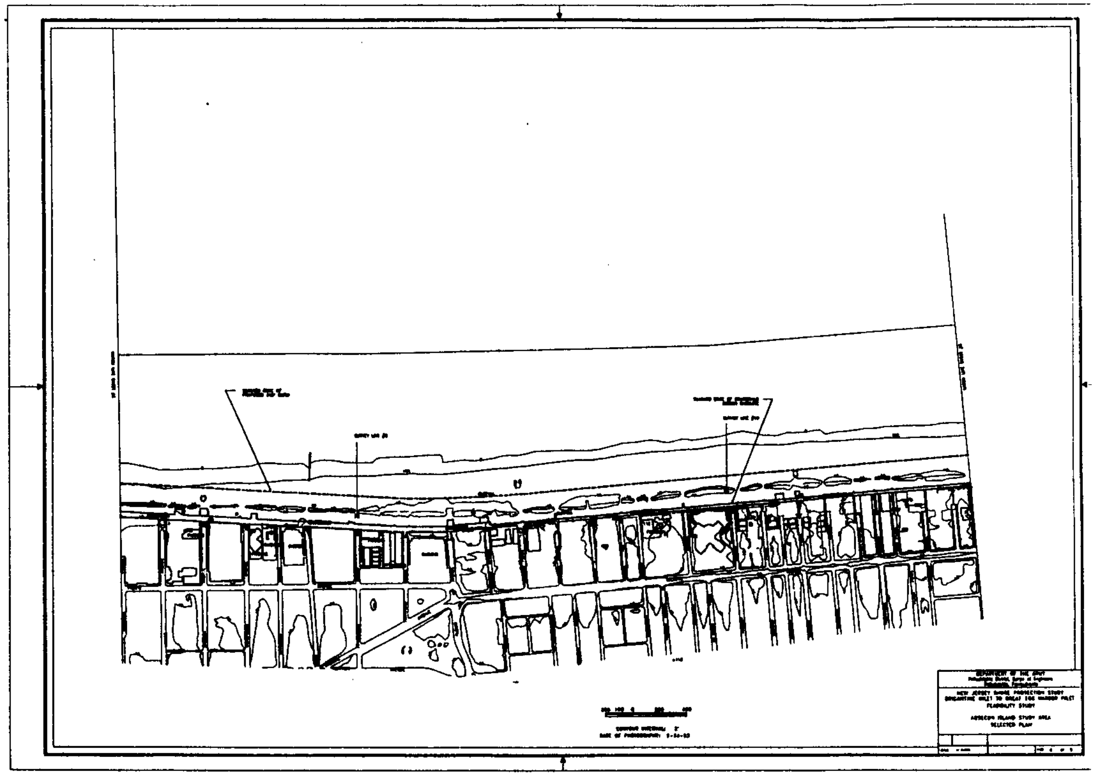
493. The local communities may have special, site specific requirements for beach access appurtenances which may require the construction of additional, or modification of proposed access paths. This is conditionally acceptable with the COE as long as the access plans are fully coordinated with the COE to ensure no loss of project integrity, and with NJDEP for adherence to State coastal zone regulations.

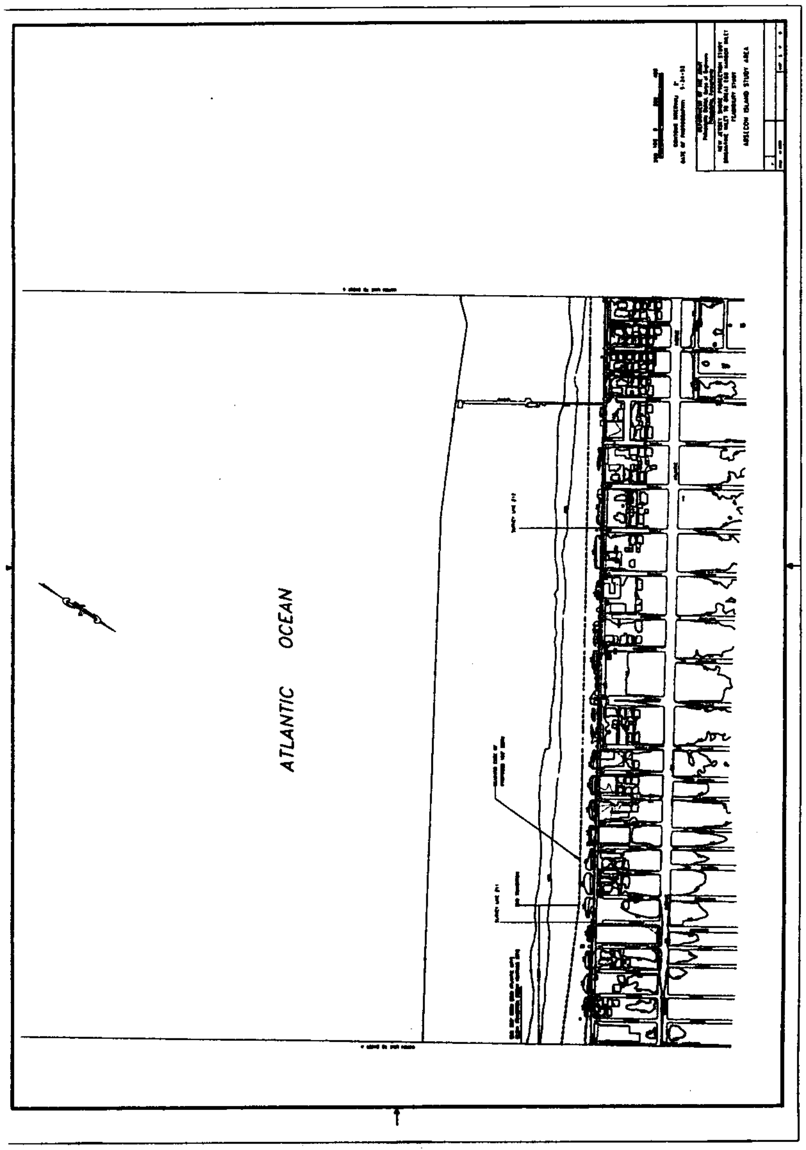
494. The plan also includes the planting of 91 acres of dune grass and the erection of 63,675 linear feet of sand fence. Survey cross sections used to develop the selected plan beachfill volumes are presented in Appendix A. Annual operation and maintenance for the dune and dune crossovers is estimated to be $32,750. [The selected plan layout is shown in figures 45 through 53].

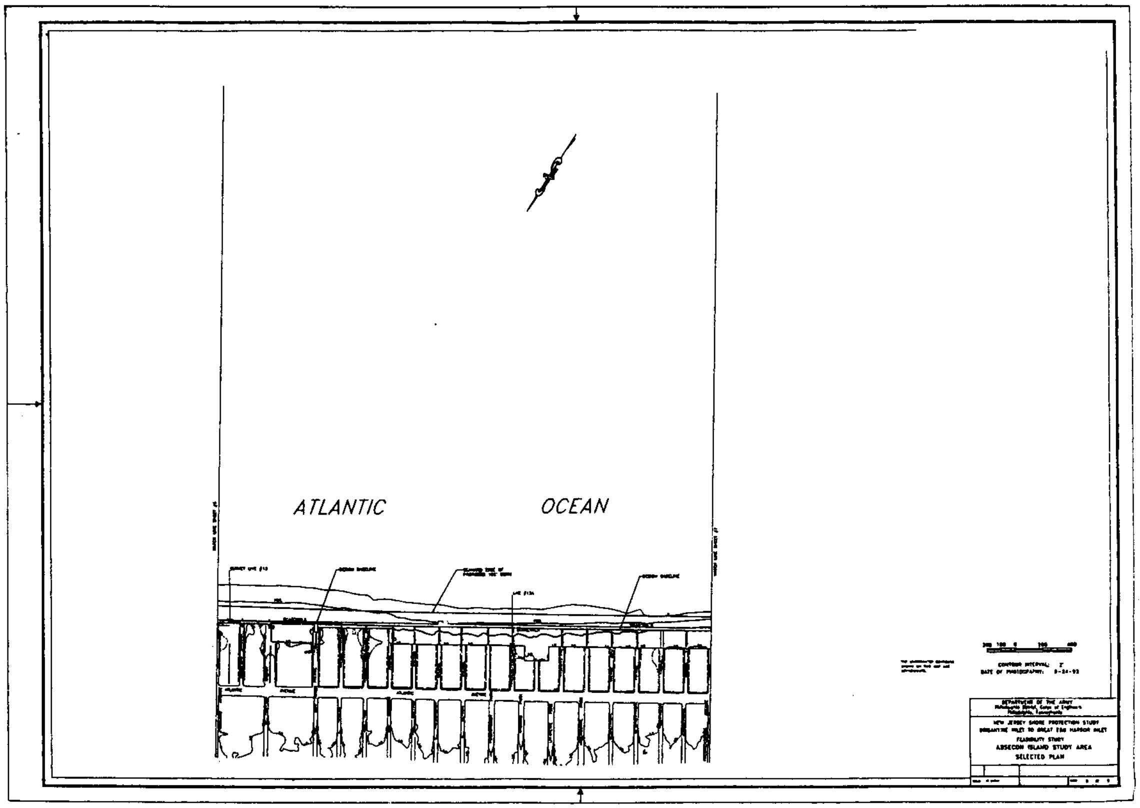

ABSECON INLET
GARDNER'S BASIN
CLAM CREEK


ATLANTIC OCEAN
ABSECON INLET


ATLANTIC OCEAN
200 100 0 200 400
SCALE
DEPARTMENT OF THE ARMY
Philadelphia District, Corps of Engineers
Philadelphia, Pennsylvania
NEW JERSEY SHORE PROTECTION STUDY
BRIGANTINE INLET TO GREAT EGG HARBOR INLET
FEASIBILITY STUDY
ABSECON ISLAND STUDY AREA
SELECTED PLAN


DEPARTMENT OF THE ARMY
Philadelphia District, Corps of Engineers
Philadelphia, Pennsylvania
NEW JERSEY SHORE PROTECTION STUDY
BRIGANTINE INLET TO GREAT EGG HARBOR INLET
FEASIBILITY STUDY
ABSECON ISLAND STUDY AREA
SELECTED PLAN
CONTOUR INTERVAL: 2'


ATLANTIC OCEAN
NEW JERSEY SHORE PROTECTION STUDY
FEASIBILITY STUDY
ABSECON ISLAND STUDY AREA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OCEAN
SURVEY LINE #13
OCEAN SHORELINE
SEAWARD EDGE OF PROPOSED 100' BERM
LINE #13A
OCEAN SHORELINE
ATLANTIC
AVENUE
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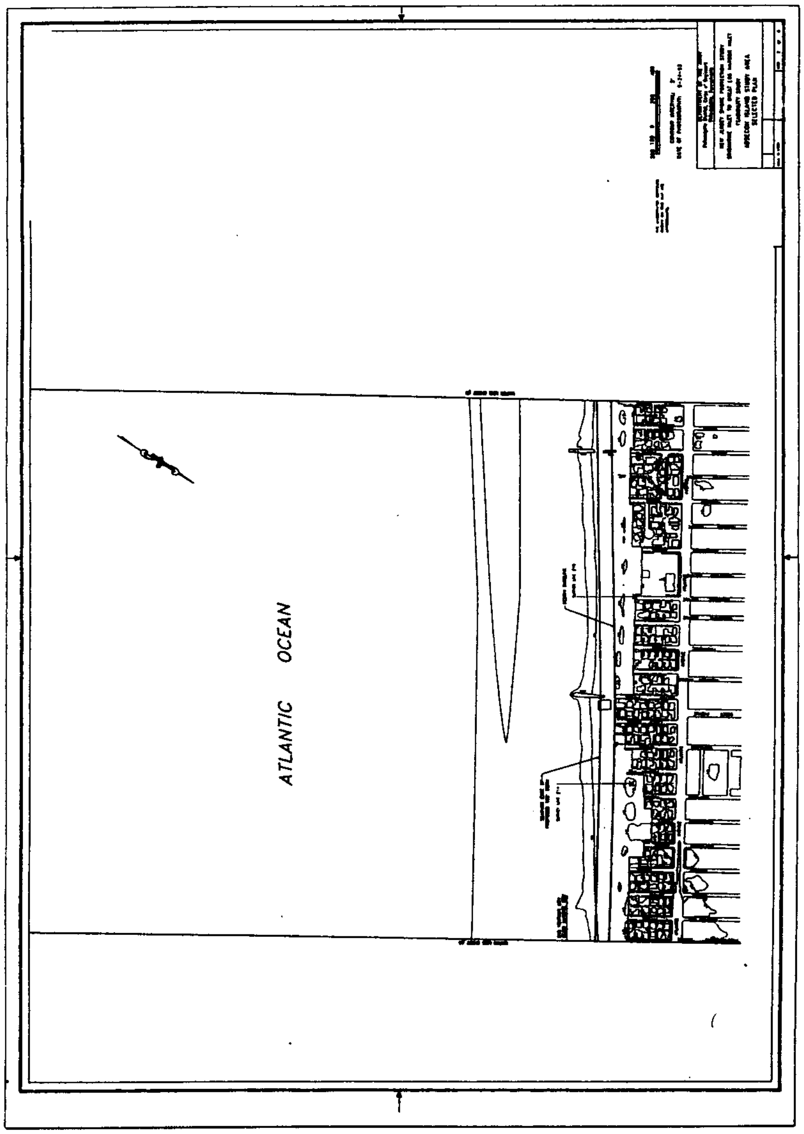
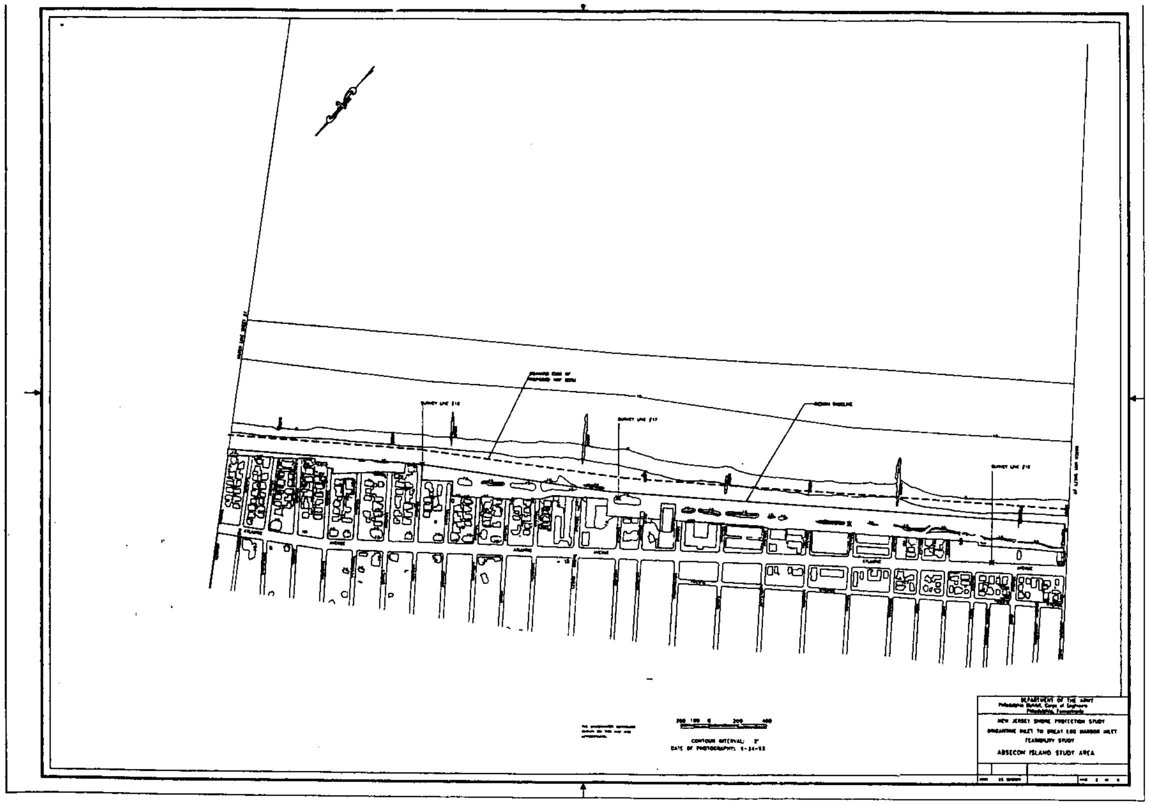
CONTOUR INTERVAL: 2'
DATE OF PHOTOGRAPHY: 9-24-93
DEPARTMENT OF THE ARMY
Philadelphia District, Corps of Engineers
Philadelphia, Pennsylvania
NEW JERSEY SHORE PROTECTION STUDY
BRIGANTINE INLET TO GREAT EGG HARBOR INLET
FEASIBILITY STUDY
ABSECON ISLAND STUDY AREA
SELECTED PLAN


ATLANTIC OCEAN
DEPARTMENT OF THE ARMY
Philadelphia District, Corps of Engineers
NEW JERSEY SHORE PROTECTION STUDY
BRIGANTINE INLET TO GREAT EGG HARBOR INLET
FEASIBILITY STUDY
ABSECON ISLAND STUDY AREA
SELECTED PLAN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SURVEY LINE 217
SURVEY LINE 218
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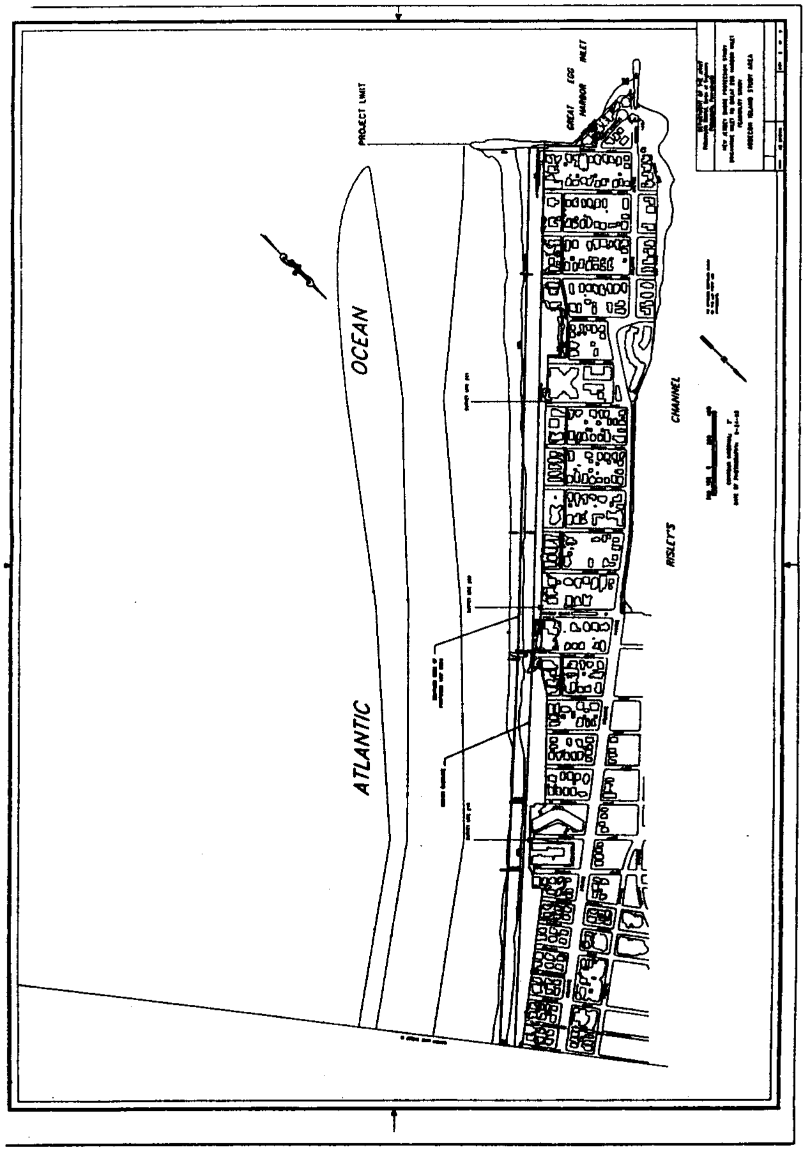
Philadelphia District, Corps of Engineers
Philadelphia, Pennsylvania
NEW JERSEY SHORE PROTECTION STUDY
BRIGANTINE INLET TO GREAT EGG HARBOR INLET
FEASIBILITY STUDY
ABSECON ISLAND STUDY AREA


ATLANTIC
OCEAN
PROJECT LIMIT
GREAT EGG HARBOR INLET
RISLEY'S
CHANNEL

495. Beachfill Taper. At the northern end of the study area, no taper of the beachfill was required because the proposed beachfill will begin at the Oriental Avenue Jetty. At the southern limit of the study, no taper was required as the proposed beachfill ends at the terminal groin in the community of Longport.

496. Transition Taper. The selected plan incorporates a transition, 1000 feet in length, from the southern end of the 200 ft. berm width in Atlantic City to the beginning of the 100 ft. berm width in Ventnor.

497. Outfall Extensions. Outfalls that do not extend past the construction template will require extensions so that they remain functional. Outfall extension quantities and costs are given in detail in Appendix E. The total cost of all outfall extensions is $787,154. The annual operation and maintenance of the project includes repairs to the storm drain outfall pipes and timber crib structures that may be damaged by storms or suffer deterioration over time. The annual cost for these repairs is estimated to be $17,700 and is based on operation and maintenance experience for projects within the Philadelphia District having similar exposure to the ocean environment.

498. Major Rehabilitation. Major rehabilitation quantities were developed in accordance with ER1110-2-1407 to identify additional erosional losses from the project due to higher intensity (low frequency) storm events. The nourishment rates developed for the project alternatives include losses due to storms that have occurred within the analysis period, storms of approximately 50 year return period and more frequent are encompassed in those rates. Major rehabilitation losses are computed as the losses that would occur from the 50% risk event over the project life. The annual percent frequency event with a 50% risk during the 50 year economic project life is 1.37%. The period of record of stages recorded at the study area is approximately 73 years, and the storm of record was the March 1962 northeaster. This storm was not only the stage of record but also by far induced the greatest loss of beach material during the period. The 1962 northeaster was considered to be the 50% risk event for the purposes of the major rehabilitation analysis. SBEACH was employed to compute volumetric erosion from the selected beach alternative design profile utilizing the hydraulic input parameters from the 1962 northeaster. Water levels and waves were hindcasted at the study area for the storm, and all model parameters were identical to the without and with-project analyses. Volumetric storm induced erosion was computed within each cell for the design beach profile and then an average loss quantity was computed for Atlantic City, Ventnor, Margate and Longport. Based on methodologies and experience developed at the Philadelphia, Wilmington and New York Districts, Corps of Engineers, it is has been estimated that between 60 and 75 % of the material displaced during large storms will return to the foreshore within weeks and only the remaining 25 to 40 % will require mechanical replacement. Therefore, as an estimate of the necessary major rehabilitation quantity, a volume equal to 50% of the estimated eroded volume will require mechanical placement onto the beach to regain the design cross-section and insure the predicted level of storm damage reduction.

499. It is estimated that volumes of 335,850 and 297,830 cubic yards within Atlantic City and Ventnor Margate and Longport, respectively, would be required to perform major rehabilitation in response to the 50% risk event over the project life.

500. Absecon Inlet Frontage. The selected plan for the Absecon Inlet frontage consists of the construction of an anchored timber sheet-pile bulkhead in two separate sections; one from Madison Ave. to Melrose Ave., for a length of 550 feet, and one section from Atlantic Ave. to Oriental Ave., for a length of 1,050 feet. The timber sheet-pile bulkhead would be aligned with the existing bulkhead constructed along Maine Ave. at both locations. From Atlantic to Oriental Aves., the bulkhead would be located at the seaward edge of the existing boardwalk. Both sections of bulkhead would be constructed to a top elevation of +14 NGVD, with king piles and steel tie rods. A revetment of rough quarrystone with a ten foot crest width and seaward slope of 2H:1V will be constructed to an elevation of +5 NGVD on the inlet side of the bulkhead. This bulkhead would prevent damages from inundation and wave attack. A cross section of this bulkhead is shown in Figure 34. Analysis of revetment stone size is also presented in the Engineering Appendix.

501. Real Estate. Real estate requirements include fill easements, temporary and permanent access easements, and borrow area easements (see the Real Estate Plan, Appendix E). The borrow area easements will be provided at no cost by the State of New Jersey. Real estate acquisition costs are zero, however, administration costs associated with obtaining easements are estimated at $107,728. Storm drain outfall extensions are considered items of relocation and are the responsibility of the local sponsor.

INITIAL PROJECT COST ESTIMATE

502. The estimated first cost for the selected plan described above is $52,146,000 October 1995 price level) which includes interest during construction, real estate acquisition costs (including administrative costs), engineering and design (E&D), construction management (CM) and associated contingencies. E&D costs include preparation of plans and specifications, environmental, cultural and coastal pre-construction monitoring and the development and execution of the Project Cooperation Agreement (PCA). A summary of the first cost is shown in Table 46.

TABLE 46
TOTAL FIRST COST SUMMARY
OCTOBER 1995 PRICE LEVELS

Description of Item	Qty	Unit	Unit Price	Est. Amount	Contingency	Total Amount
Lands and Damages						
Post Authorization Planning	0	0	0	0	0	0
Relocations (Outfall extensions)	0	Job	LS	684,482	102,672	787,154
Required Easements Incl Surveys, Appraisal and Admin	0	Job	LS	93,675	14,053	107,728
Total Lands and Damages	0	0	0	778,157	116,725	894,882
Beach Replenishment and Bulkhead Construction						
Mobilization, Demobilization and Preparatory Work		Job	LS	378,515	45,422	$423,937
Beachfill	6,174,013	CY	5.64	34,821,433	5,204,693	$40,044,648
Dune Grass	440,440	SY	2.41	1,061,460	159,219	$1,220,679
Sand Fence	63,675	LF	3.89	247,696	37,154	$284,850
Bulkhead w/ revetment	1,600	LF	LS	4,461,006	669,152	$5,130,158
Planning, Engineering and Design (PED)		Job	LS	1,105,000	165,750	$1,270,750
Construction Management (S&A)		Job	LS	2,500,959	375,144	$2,876,103
Total Beach Replenishment				$44,576,069	$6,675,056	$51,251,125
Project Total						
Total Project First Cost				$45,354,226	$6,791,781	$52,146,007

503. Interest During Construction. Table 47 displays the calculations for interest during construction. The duration of construction for the project is estimated at nineteen months. It is assumed the construction costs would be evenly distributed over that period.

504. Total Sand Quantity Required. The beachfill project requires a conservative estimate of approximately 32 million cubic yards over its anticipated 50 year project life. Initial construction of the project would require approximately 6.2 million cubic yards while the periodic nourishment is estimated at 1.7 million cy every three years. Approximately 300,000 cy of material per year is estimated to infill the Absecon Inlet borrow site (Site A) between nourishment intervals (900,000 total for the 3 yr cycle). This is a difficult quantity to predict and is viewed as a conservative estimate, particularly after the project is constructed. Our sediment budget analyses (Appendix A) indicate that there is considerably more sand currently being transported in the littoral system along Absecon Inlet (on the order 550,000 cy).

505. Following the construction of the project, additional sand will become available to the ongoing littoral processes. Thus, there should be a significant increase in the gross transport of sand, most notably from the northern portion of Atlantic City, both north into the inlet as well as further south along Absecon Island. In addition, once the Absecon Inlet borrow site has been dredged, it will create a localized sediment sink which will be more effective at trapping sand entrained in the littoral system. Therefore, the actual infilling of Site A may be greater than predicted. This would cause Site A to have additional longevity over what is currently estimated.

506. Based on existing bathymetry (1994), Site A contains approximately 10.3 million cy of beach quality sand. An additional 1 million cy of material is estimated to naturally deposit into Site A area prior to construction, for a future total of approximately 11.3 million cy. Assuming an initial beachfill requirement of 6.2 million cy, that would leave a balance of just over 5 million cy for future nourishment efforts (in addition to the infilling volume of 900,000 cy per 3 yr cycle). Therefore, the Absecon Inlet site can reasonably be expected to be the sole source of beachfill material for the initial construction and first six to seven nourishment efforts (approximately years 2019-2022). Post project monitoring will confirm the actual beach losses and borrow site infilling. Changes in nourishment requirements, grain size distributions, infilling rates, etc., could either increase or decrease the projected time horizon for sole utilization of Site A for sand mining. Supplemental sand requirements during the life of the project would then be available from the other two borrow sites identified, or other alternative future sites, on an as needed basis.

507. Periodic Nourishment. Periodic nourishment is expected to occur at 3 year intervals subsequent to the completion of initial construction. Based on a volume of 1,666,000 cubic yards for each nourishment cycle, the total cost per operation, or cycle, is estimated to be $12,188,000 (October 1995 price levels). The total estimated annualized cost of periodic nourishment is $8,133,859 over the 50 year life of the project.

508. Annualized Construction Costs. Annualized costs including first costs, real estate costs, interest during construction, and major rehabilitation costs are shown in table 48.

509. Project Monitoring Plan. The project monitoring plan will document beach fill performance

and determine conditions within the borrow areas. Periodic assessments will assist in determining renourishment quantities. The program was developed in accordance with EM-1110-2-1004, ER-1110-2-1407, CETN-II-26 and the draft CETN dated 3/13/95 entitled "Recommended Base-level Physical Monitoring of Beach Fills." The following items are to be included in the project monitoring plan: Pre- and post-construction monitoring will consist of beach profile surveys, sediment sampling of the beach and borrow areas, aerial photography, and tidal data collection. The field data collection will be followed up by lab and data analyses. The proposed monitoring program will begin at the initiation of pre-construction efforts and continue throughout the project life. The monitoring program is further described in Appendix A, Section 2. Costs of the monitoring plan can be seen in table 49.

Table 47

ABSECON ISLAND INTEREST DURING CONSTRUCTION			
Discount Rate:		7.625%	
Use Date:		Apr-1999	
Start Date:		Nov-2000	
MONTH	Monthly Costs	Interest Factor	Total Cost
1	$3,942,725	1.123386	$4,429,204
2	$2,671,975	1.116528	$2,983,336
3	$2,671,975	1.109712	$2,965,123
4	$2,671,975	1.102937	$2,947,021
5	$2,671,975	1.096204	$2,929,030
6	$2,671,975	1.089512	$2,911,149
7	$2,671,975	1.082861	$2,893,377
8	$2,671,975	1.076250	$2,875,713
9	$2,671,975	1.069680	$2,858,157
10	$2,671,975	1.063149	$2,840,709
11	$2,671,975	1.056659	$2,823,367
12	$2,671,975	1.050208	$2,806,130
13	$2,671,975	1.043797	$2,788,999
14	$2,671,975	1.037425	$2,771,973
15	$2,671,975	1.031091	$2,755,050
16	$2,671,975	1.024797	$2,738,231
17	$2,671,975	1.018540	$2,721,515
18	$2,671,975	1.012322	$2,704,900
19	$2,671,975	1.006142	$2,688,387
Total First Cost:	$52,146,000		
	Total Investment Cost:		$55,546,000
	Minus First Cost:		$52,146,000
	Interest During Construction:		$3,400,000

Table 48

ABSECON ISLAND
BEACHFILL & NOURISHMENT
PRESENT WORTH ANALYSIS

Base Year:		2001	Discount Rate:	7.625%
Type	Year	Cost	PW Factor	PW Cost
Initial Cost	0	52,038,300	1.000000	52,038,300
Real Estate (Admin. Costs)	0	108,000	1.000000	108,000
IDC	0	3,400,000	1.000000	3,400,000
Periodic Nourishment	3	12,187,595	0.802159	9,776,390
Periodic Nourishment	6	12,187,595	0.643459	7,842,220
Periodic Nourishment	9	12,187,595	0.516157	6,290,708
Periodic Nourishment	12	12,187,595	0.414040	5,046,149
Periodic Nourishment	15	12,187,595	0.332126	4,047,814
Periodic Nourishment	18	12,187,595	0.266418	3,246,991
Periodic Nourishment	21	12,187,595	0.213709	2,604,603
Periodic Nourishment	24	17,372,450	0.171429	2,978,140
Periodic Nourishment	27	12,187,595	0.137513	1,675,956
Periodic Nourishment	30	12,187,595	0.110308	1,344,383
Periodic Nourishment	33	12,187,595	0.088484	1,078,409
Periodic Nourishment	36	12,187,595	0.070978	865,056
Periodic Nourishment	39	12,187,595	0.056936	693,912
Periodic Nourishment	42	12,187,595	0.045672	556,628
Periodic Nourishment	45	12,187,595	0.036636	446,504
Periodic Nourishment	48	12,187,595	0.029388	358,167
			TOTAL	104,398,331
Capital Recovery Factor (50 Years @ 7.625%):				0.078235
AVERAGE ANNUAL COSTS:				**$8,167,600**

Table 49

		MONITORING COSTS PRESENT WORTH COST ANALYSIS		
Base Year		2001	0	
Discount Rate		7.625%		
TYPE	YEAR	COST	PW FACTOR	PW COST
Monitoring	0	0	1.000000000	0
Monitoring	1	284000	0.929152149	263879
Monitoring	2	251000	0.863323715	216694
Monitoring	3	284000	0.802159085	227813
Monitoring	4	251000	0.745327838	187077
Monitoring	5	284000	0.692522962	196677
Monitoring	6	251000	0.643459198	161508
Monitoring	7	284000	0.597871496	169796
Monitoring	8	251000	0.555513585	139434
Monitoring	9	284000	0.516156641	146588
Monitoring	10	251000	0.479588052	120377
Monitoring	11	284000	0.445610269	126553
Monitoring	12	251000	0.414039739	103924
Monitoring	13	284000	0.384705913	109256
Monitoring	14	251000	0.357450326	89720
Monitoring	15	284000	0.332125738	94324
Monitoring	16	251000	0.308595344	77457
Monitoring	17	284000	0.286732027	81432
Monitoring	18	251000	0.266417679	66871
Monitoring	19	284000	0.247542558	70302
Monitoring	20	251000	0.230004700	57731
Monitoring	21	284000	0.213709361	60693
Monitoring	22	251000	0.198568512	49841
Monitoring	23	284000	0.184500360	52398
Monitoring	24	251000	0.171428906	43029
Monitoring	25	284000	0.159283536	45237
Monitoring	26	251000	0.147998640	37148
Monitoring	27	284000	0.137513254	39054
Monitoring	28	251000	0.127770736	32070
Monitoring	29	284000	0.118718454	33716
Monitoring	30	251000	0.110307506	27687
Monitoring	31	284000	0.102492456	29108
Monitoring	32	251000	0.095231086	23903
Monitoring	33	284000	0.088484168	25130
Monitoring	34	251000	0.082215255	20636
Monitoring	35	284000	0.076390481	21695
Monitoring	36	251000	0.070978379	17816
Monitoring	37	284000	0.065949714	18730
Monitoring	38	251000	0.061277318	15381
Monitoring	39	284000	0.056935952	16170
Monitoring	40	251000	0.052902162	13278
Monitoring	41	284000	0.049154158	13960
Monitoring	42	251000	0.045671691	11464
Monitoring	43	284000	0.042435950	12052
Monitoring	44	251000	0.039429454	9897
Monitoring	45	284000	0.036635962	10405
Monitoring	46	251000	0.034040383	8544
Monitoring	47	284000	0.031628695	8983
Monitoring	48	251000	0.029387870	7376
Monitoring	49	284000	0.027305802	7755
Monitoring	50	0	0.025371245	0
			TOTAL	3,420,567
Capital Recovery Factor (50 Years @ 7.625%)				0.07823491724
	AVERAGE ANNUAL COSTS			$267,608

TOTAL ANNUALIZED COSTS

510. The estimated total annualized cost of the selected plan is $8,504,281, which is based on an economic project life of 50 years and an interest rate of 7.625% (October 1995 price levels). This cost includes the annualized first cost, interest during construction, annualized periodic nourishment costs, annualized major rehabilitation costs and post construction monitoring costs.

511. CONSTRUCTION AND FUNDING SCHEDULE. An estimated schedule of expenditures by year is shown in the Project Management Plan (PMP). The PMP describes activities leading to, through and after construction of the selected plan.

INCIDENTAL BENEFITS

512. RECREATION BENEFITS. Incidental recreation benefits are included in the final accounting of total benefits of the selected plan.

513. Without Project Conditions. New Jersey Beaches are consistently the number one travel destination in New Jersey. Tourist dollars contribute directly and indirectly to the regional economy. In 1992, the New Jersey Travel Research Program reported that travel and tourism generated 346,000 jobs in the state with a total payroll of $7.6 billion. In addition, the number of visitors to Atlantic City has recently experienced a slight increase. In 1994 the total number of visitors was an estimated 31.3 million according to the South Jersey Transportation Authority. This represented a 3.6% increase over the previous year's visitor count.

514. A contingent valuation method survey was completed by the Rutgers State University for the New Jersey Department of Environmental Protection and the U.S. Army Corps of Engineers to determine willingness to pay for the existing beach and an enhanced beach. This is done on a regional basis, encompassing the major beach communities of Atlantic City, Ventnor, Margate, and Longport. It consisted of 1,063 interviews of a random sample of recreational beach users. The interviews were conducted in person on the beach during the summer of 1994.

515. Beachgoers were asked to indicate how important different factors were in deciding whether to visit a New Jersey beach. Respondents voiced similar desires. The primary factors of consideration were the quality of the beach scenery, how well maintained the beach was, the width of the beach, the number of lifeguards, and how family oriented was the beach.

516. The survey also used a density measure developed in cooperation with the Corps to determine if crowding was a problem. It was found that over 60% of the time there was at least several yards of space between beach towels or blankets, and only 7% of the time was it very crowded (only 2 feet between towels). Further it was determined that crowding was not considered a very important issue to the majority of beachgoers by asking respondents how important being alone is and how important is it to be with a large number of people. As might be expected, areas with more crowding tended to be frequented by people who like large numbers.

People who like to be alone frequented areas that tended to have little crowding.

517. To estimate the value of the beach as it exists currently, an iterative bidding process was applied. Beachgoers were first asked if a day at the beach would be worth $4.00 to each member of their household. Based on their answers, they were then asked progressively higher or lower amounts until the amount they value the beach was determined. Using this method it was found that the average value of a day at the beach is $4.22.

518. With Project Conditions. The beachgoers were asked how much more they were willing to pay if the beach were widened. While the majority were unwilling to pay any extra, 16% were willing to pay, on average, $2.92 more per visit. This would be equivalent to an average of $0.47 for all beachgoers.

519. The number of visitor days was estimated by multiplying the number of beach tag sales by the number of days the tags are usable. This was then multiplied by 1.062 to capture the percentage of people who use the beach without buying a beach tag. Lastly, 30% is subtracted from the number to account for inclement weather. For Atlantic City, which does not sell beach tags, the number was taken from city estimates. The total number of visitor days for beaches within the project area are estimated at 14,815,000.

520. Benefits were not found to accrue from increased capacity because crowding was found not to be a significant factor. However benefits do arise from an increase in the value of the recreational experience.

521. Benefits resulting from this increase in recreational experience were calculated by multiplying $0.47 by the number of visitors days within the project area or 14,815,000. This gives total recreational benefits of $6,963,000. A breakdown of benefits for each community are as follows in table 50:

Table 50
Recreation Benefits

Community	Visitor Days	Day Value	Total Value
Atlantic City	9,800,000	$0.47	$4,606,000
Margate	2,093,000	$0.47	$983,710
Ventnor	2,267,000	$0.47	$1,065,490
Longport	655,000	$0.47	$307,850
Total	14,815,000	$0.47	$6,963,050

522. REDUCED MAINTENANCE BENEFITS. In addition to storm damage reduction benefits, reduced maintenance benefits accrue under the with-project scenario. It is anticipated that the proposed berm and dune restoration plan for Atlantic City will result in a yearly reduction in local maintenance and repair costs of $2,000. The geotube installation sustained minor damages by the passing offshore of Hurricane Erin in 1995. At the time, there was virtually no beach fronting the geotubes. Waves removed the sand veneer and undercut portions of geotubes. With a 200 ft berm in place, it is assumed that under high frequency storm conditions, damage to the geotubes will be prevented, thereby eliminating the need for maintenance.

523. It is also anticipated that maintenance of other shore protection structures will be reduced, however reliable figures are unavailable. The benefits claimed in this category are therefore considered conservative.

524. BENEFITS DURING CONSTRUCTION. The NED project will be constructed over nineteen months. Significant portions of the beach will be fully nourished before the project is completed in its entirety. The portions of the beach nourished early in the construction phase will provide storm damage reduction benefits. The total annualized benefits during construction are $479,000. Table 51 displays the monthly benefits during construction and the average annual benefits this adds to the overall benefits.

Table 51

ABSECON ISLAND BENEFITS DURING CONSTRUCTION				
	Discount Rate:		0.07625	
	Use Date:		Apr-1999	
	Start Date:		Nov-2000	
Month	Work	Monthly Benefit	Interest Factor	Total Benefit
1	Mob.	0	1.123386	0
7	Atlantic City	400,106	1.082861	433,259
8	Atlantic City	400,106	1.076250	430,614
9	Atlantic City	400,106	1.069680	427,985
10	Atlantic City	400,106	1.063149	425,372
11	Atlantic City	400,106	1.056659	422,776
12	Atlantic City	400,106	1.050208	420,195
13	Atlantic City	400,106	1.043797	417,629
14	Atlantic City	400,106	1.037425	415,080
15	Atlantic City	400,106	1.031091	412,546
16	Atlantic City	400,106	1.024797	410,027
17	Atlantic City	400,106	1.018540	407,524
18	Ventnor-Margate-Longport	742,628	1.012322	751,779
19	Demob	742,628	1.006142	747,189
	TOTAL	$5,886,422		$6,121,976
Capital Recovery Factor (50 Years @ 7.625%):				0.078235
Benefits During Construction:				$479,000

ECONOMICS OF THE NED PLAN

525. BENEFIT-COST RATIO. With the inclusion of the recreation benefits, the combined project (both reaches) for the study area provides total average annual benefits of $16,356,000 at a total average annual project cost of $8,486,000. Total average annual benefits are displayed by category in Table 52, along with annualized costs, and the resulting benefit-cost ratio. The result is a benefit-cost ratio of 1.9 with $7,870,000 in net benefits.

Table 52

BENEFIT-COST COMPARISON FOR THE NED PLAN

Discount Rate:	7.625%
Project Life:	50 Years
Price Level:	Oct. 1995
Base Year:	2001
BENEFITS:	
Storm Damage Reduction	$8,912,000
Reduced Maintenance	2,000
Recreation	6,963,000
Benefits During Construction	479,000
Total Average Annual Benefits	$16,356,000
COSTS:	
Initial Construction Costs	$52,146,000
Interest During Construction	3,400,000
Periodic Nourishment (per cycle)	12,188,000
Average Annual Construction Costs	$8,168,000
Average Annual Monitoring Costs	$268,000
Average Annual O&M Costs	$51,000
Total Average Annual Costs	$8,486,000
Benefit-Cost Ratio	**1.9**
Net Benefits	**$7,870,000**
Residual Damages	**$3,535,000**

PROJECT IMPACTS

526. IMPACTS TO ENVIRONMENTAL RESOURCES. The primary adverse impact of the beach nourishment alternative is the temporary disturbance and destruction of existing benthic

resources from dredging operations at the borrow area and fill placement along the shorefront. Dredging in the borrow area will result in a temporary destruction of the benthic community, however, rapid recolonization is expected to occur within one year from the dredging. Minor shifts in benthic community composition may occur following recolonization. Beachfill operations along Absecon Island will result in temporary degradation of the existing beach habitat during initial construction and the periodic nourishments. Existing benthic organisms on the beach would become buried as a result of beachfilling operations. Due to the presence of species adapted to high energy and dynamic conditions, recolonization of the beach area is expected to be rapid. The portion of benthic habitat covered by any seaward extension of the beach would represent a long-term loss, however, this would be offset by the creation of similar habitat. The partial burial of groins in the project area would represent a long-term loss of rocky inter-tidal habitat occupied by aquatic invertebrates that attract birds and fish. Fish and avian utilization of the immediate shoreline area for feeding would be temporarily disrupted, however, they are expected to return immediately after the disturbance. Dredging and the hydraulic placement of beachfill material will result in temporary higher turbidity levels at the borrow site and waters along the shoreline during construction.

527. In order to minimize the impacts to surf clams within the project area, dredging activities will primarily take place within the Absecon Inlet borrow area for the initial construction, as well as the subsequent nourishment cycles. If, due to available sand quantities, it becomes necessary to utilize one of the other borrow areas for subsequent nourishment cycles, updated surveys will be done to determine current populations. Measures will be taken in Absecon Inlet, as well as the other borrow areas if necessary, to minimize impacts to the clams. Some of these measures may include the commercial harvest of clams prior to dredging and only disturbing a portion of the site. All measures will be fully coordinated with the appropriate Federal, state and local agencies.

528. The piping plover, which is a frequent inhabitant of New Jersey's sandy beaches. Past nesting sites of this species in New Jersey have included the southern end of Brigantine, Ocean City, and several locations in Cape May. No known nesting sites have been identified within the study area on Absecon Island. Based on the high development and human disturbance, it is unlikely for piping plovers to nest within the project area. However, if a piping plover nest is discovered within the project area prior to the commencement of initial beach nourishment and periodic nourishment activities, the Corps will contact the New Jersey Department of Environmental Protection, Division of Fish, Game and Wildlife and the U.S. Fish and Wildlife Service to determine appropriate measures to protect the piping plovers from being disturbed. These measures may include establishing a buffer zone around the nest, and limiting construction to be conducted outside of the nesting period (1 April - 15 August).

529. The construction of the timber sheet-pile bulkheads and placement of a quarrystone revetment will also result in temporary higher turbidity levels and the disturbance of the benthic community within the inlet. This aspect of the proposed plan will result in the loss of sandy bottom habitat and the destruction of the benthic community within the area to be covered by the bulkheads and associated revetment. Once construction is completed, it is expected that the newly created rocky inter-tidal habitat will be colonized with a variety of marine organisms.

530. Depending on the dredging method to be used, it may be necessary to employ sea turtle monitors on the dredges to comply with Section 7 of the Endangered Species Act.

531. Periodic dredging in the borrow area for beach renourishment may affect a potentially recovering surf clam population. The resource agencies will be contacted prior to renourishment cycles in order to determine if monitoring is appropriate.

532. Mitigation measures were incorporated into the determination of the optimal nourishment interval. The mitigation measures were initiated by the selection of the beach nourishment alternative. This alternative offers a more naturalistic and softer approach for storm damage reduction. Selection of this alternative is based on its relatively low ecological impacts and its cost effectiveness. Another institutional measure is the utilization of offshore sand borrow areas. These are characterized by high energy and shifting sands resulting in a benthic community of lower abundance and diversity as compared to more stable benthic environments. Therefore, biological impacts are expected to be lower. Another measure is the selected use of suitable sand grain sizes for beach nourishment. The selection of borrow areas is based on compatibility studies for sand grain sizes. The selection of coarser beach nourishment quality material will minimize impacts on water quality at the dredging site and discharge (placement) site. A more detailed discussion of the mitigation effort is detailed in Section 5.16 of the FEIS.

533. Aesthetics. Beach nourishment is a more natural and soft structural solution to reducing storm damages on Absecon Island. With the exception of short-term impacts during construction, overall aesthetics of the beach would be improved as a result. A natural-looking beach and dune would be more aesthetically pleasing and attractive to residents and tourists. However, despite the visual benefits the beach nourishment alternative would provide, a restored dune may inhibit ocean views in some project impact areas.

534. The boardwalk elevations on Absecon Island range from 10.5 to 15 feet NGVD. At the lower elevations, views of the ocean may be impacted. However, of the 3.4 miles of boardwalk in Atlantic City, only seven percent is below 11 feet NGVD. Therefore, in these areas, the possibility exists for some aesthetic impacts in terms of the accessibility of wave and ocean views. Currently there are some areas within Absecon Island that have limited views of the ocean. This is due to the fact that dune repairs/restoration have been made in some areas which have increased the height of the dunes. This, combined with the narrow width of the beach, leaves the waves breaking close to the toe of the dunes and hampering the visual aesthetics. If the dunes for the proposed project were built on the current beach, aesthetic impacts would also exist due to the fact that currently the waves break very close to the toe of the dune in many areas of the project. Once the proposed beachfill is in place however, the area where the waves break will be much further from shore, therefore making the waves easier to see from the boardwalk, and minimizing negative aesthetic impacts.

535. IMPACTS TO CULTURAL RESOURCES. On the basis of the current project plan, the Corps is of the opinion that proposed dredging operations at borrow areas, fill placement along the shoreline and within near-shore underwater locations, and bulkhead and revetment

construction adjacent to the inlet will have no effect on significant cultural resources.

536. The remote sensing investigation of the borrow areas identified five magnetic targets exhibiting shipwreck characteristics. Proposed sand borrowing activities could adversely impact these target locations, which may represent significant cultural resources. Therefore, in order to eliminate construction impacts at these locations, the Philadelphia District proposes to completely avoid these remote sensing targets during sand borrowing operations by delineating at least a 200 foot buffer around each target (see figure 54).

Absecon Inlet Borrow Site with Exclusion Zone Locations

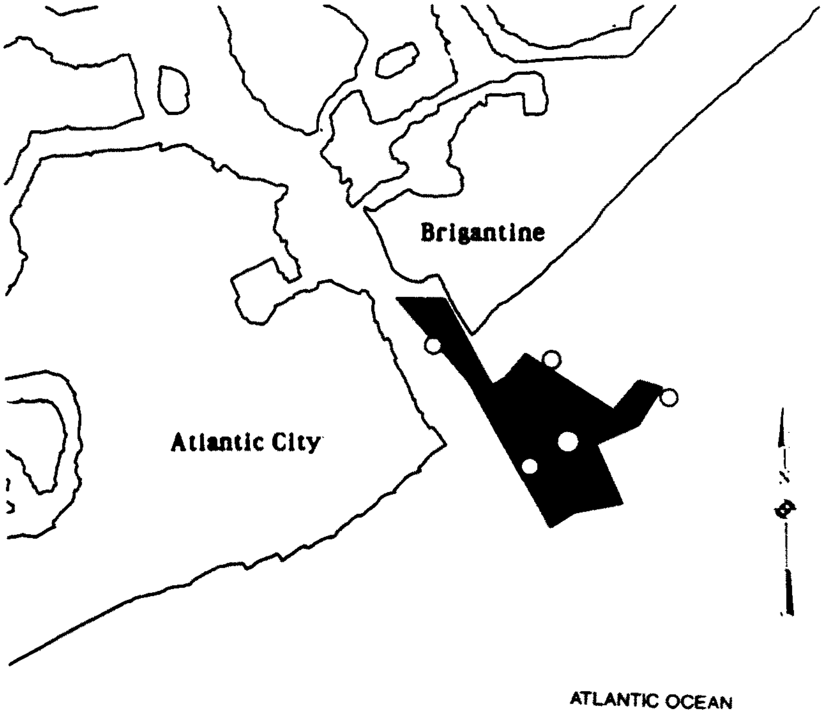


FIGURE 54

537. A low-tide pedestrian survey conducted along the shoreline did not identify any prehistoric or historic archaeological sites within the project boundaries. Two potentially significant historic entertainment piers, the Steeplechase Pier and the Garden Pier, are located in the project area and will not be impacted by fill placement. Near-shore underwater project areas were not investigated for cultural resources. Remote sensing survey within this high energy surf-zone is dangerous and extremely difficult. The likelihood for intact and undisturbed cultural resources in such an unstable and shifting coastal environment is very minimal.

538. Timber sheet-pile bulkhead and quarrystone revetment construction is limited to previously disturbed areas adjacent to Maine Avenue and within Absecon Inlet. Previous bulkhead construction and inlet dredging activities have minimized the likelihood for significant cultural resources in these locations. Therefore, cultural resources, pedestrian or remote sensing surveys were not conducted in these areas.

539. RISK AND UNCERTAINTY ASSOCIATED WITH COASTAL PROJECTS. The Corps of Engineers has a long history of planning coastal protection measures as well as other types of water resources development projects. By providing protection against coastal hazards, gains in economic efficiency can be achieved that result in an increase in the national output of goods and services. A comprehensive guide for calculating NED benefits primarily for storm damage reduction and shore protection projects is contained in IWR Report 91-R-6 National Economic Development Procedures Manual - Coastal Storm Erosion, U.S. Army Corps of Engineers, Institute for Water Resources, September 1991.

540. Coastal protection projects, like all investments, involve an outlay of capital at some point in time in order to gain predicted benefits in the future. In addition, certain types of projects, particularly beach fill and periodic nourishment projects, require a commitment to substantial future spending to sustain the projects and continue to gain the related benefits. In 1956, Congress defined periodic nourishment as construction for the protection of shores when it is the most suitable and economical remedial measure. One advantage to soft engineering options, such as beach fill, is that they do not represent an irrevocable commitment of funds. They can be discontinued at any future point in time, eventually allowing a return to the pre-project condition, without further expenditures.

541. In all evaluations, the aspect of future costs and benefits requires that the current and future dollar costs and benefits be compared in a common unit of measurement. This is typically accomplished by comparing their present values or the average annual equivalent of their present values. Therefore, the discount or interest rate used to determine the present values influences the relative economic feasibility of alternative project types. Since high discount rates reduce the influence of future benefits and costs on present values, high interest rates generally favor the selection of projects with low first costs but relatively high planned future expenditures over those with high first costs but low future cost requirements. This factor, among other important considerations, tends to favor the wide use of beach fills, dunes, and accompanying renourishment relative to an extensive use of hard structural shore protection measures.

542. One standard for identifying and measuring the economic benefits from investments in a water resources project such as shore protection, is each individual's willingness to pay for that project. For coastal projects, this value can be generated by a reduction in the cost to a current land-use activity or the increase in net income possible at a given site. A project generates these values by reducing the risk of storm damage to coastal development. Conceptually, the risk from storms can be viewed as incurring a cost to development, i.e., capital investment, at hazardous locations. Thus, the cost per unit of capital invested at risky locations is higher than at lesser risk locations.

543. Natural Sources of Risk and Uncertainty. Storms and severe erosive processes damage coastal property in several ways. In addition to direct wind-related damage, which is ignored for purposes of this discussion, a storm typically produces an elevated water surface or surge above the normal astronomical tide level. This storm-driven surge is often sufficient, even without the effects of waves, to be life-threatening and/or to cause substantial inundation damages to property.

544. In addition to the surge, coastal storms generate large waves. Properties subject to direct wave attack usually suffer extensive structural and content damages as well as foundation scouring which can totally destroy structures. Storms also produce at least temporary physical changes at the land-water boundary by eroding the natural beach and dune that serve to buffer and protect shorefront property from the effects of storms. Increased wave energy during storms erodes the beach and carries the sand offshore. At the same time, the storm surge pushes the zone of direct wave attack higher up the beach and can subject dunes and, in turn, upland structures to direct wave action.

545. Frameworks for Deterministic and Risk-Based Evaluations. The first step in a project feasibility evaluation is to assess the baseline conditions, i.e., the conditions that would likely exist if a project was never implemented to address the existing problems in a systematic fashion. In the deterministic approach, which is currently the basic approach used by the Corps of Engineers, a single forecast defines physical, developmental, cultural, environmental and other changes expected to occur under the baseline or "without-project" condition. These changes are considered to occur with certainty in the absence of any systematic adaptive measure of the type being considered as a project. This approach does allow, however, for individual property owners to respond to storm and erosion threats by constructing protective measures or by abandoning property. It also takes into account other systematic measures that are in place or expected to be instituted such as existing state, county or municipal protective measures, evolving building codes and changing land-use controls.

546. Benefits produced by a project depend on the project's type, scale, and storm parameters. Even if two alternative projects constructed side by side experience the same storm, benefits will differ, depending on the magnitude of residual losses if the storm exceeds the alternatives' design dimensions. As an example, a beach fill, even when inundated during a storm, still provides significant residual protection. Another significant factor is that in the coastal process, the wide range of storm parameters (wind direction, wind velocity, storm surge, storm duration, etc.)

results in multiple storm damage mechanisms.

547. In addition to NED benefits, a second major consideration in applying benefit- cost analysis in choosing a particular type and size project is the stream of future project costs. The appropriate costs used in the analysis should provide a measure of all the opportunity costs incurred to produce the project outputs. These NED costs may differ from the expenses of constructing and maintaining the project. For coastal protection projects, expenses would include the first costs of project construction, any periodic nourishment and maintenance costs, and future rehabilitation costs.

548. The nature of future costs depends on the type of project. For instance, a structural type of project, e.g., a stone revetment, typically has high first costs and high future rehabilitation costs but low future maintenance costs. On the other hand, when compared to a hard structure project, a beach fill type project is composed of relatively low first costs, but larger recurring future maintenance costs (periodic nourishment).

549. Once the alternative formulated plans are evaluated in economic terms, the expected net benefits can be calculated. Following the project selection criteria in the P&G, the recommended type and scale of plan should be the one that reasonably maximizes net NED benefits. This is a key conceptual point in both the deterministic and risk analysis evaluation methodologies. Both methods apply the net benefits decision rule for selecting the economically optimal project.

550. SENSITIVITY ANALYSIS. Certain key parameters were varied to determine their effect on the economic analysis of Absecon Island.

551. Interest Rate. Project benefits and costs were annualized at higher discount rates of 8% and 10%. The results are displayed below in table 53.

Table 53

SENSITIVITY ANALYSES Discount Rate Change	
8% Discount rate:	
Average Annual Benefits:	
Storm Damage Reduction[1]	$8,914,000
Recreation	$6,963,000
Benefits During Construction	$501,400
Average Annual Benefits:	$16,378,400
Average Annual Costs[2]	$8,670,400
Benefit-Cost Ratio:	1.89
Net Benefits:	$7,708,000
10% Discount rate:	
Average Annual Benefits:	
Storm Damage Reduction	$8,914,000
Recreation	$6,963,000
Benefits During Construction	$624,800
Average Annual Benefits:	$16,501,800
Average Annual Costs:	$9,745,000
Benefit-Cost Ratio:	1.69
Net Benefits:	$6,756,800

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[1] Includes reduced maintenance

[2] Includes operation, maintenance, and monitoring

552. Replacement Cost Values. The NED plan was also rerun changing the structure and content replacement values +/- 10 percent. The results are displayed below in table 54.

Table 54

SENSITIVITY ANALYSES Replacement Cost Value Change	
+10% Structure Replacement Cost:	
Average Annual Benefits:	
Storm Damage Reduction[3]	$9,622,000
Recreation	$6,963,000
Benefits During Construction	$479,000
Average Annual Benefits:	$17,064,000
Average Annual Costs[4]	$8,476,700
Benefit-Cost Ratio:	2.01
Net Benefits:	$8,587,300
-10% Structure Replacement Cost:	
Average Annual Benefits:	
Storm Damage Reduction	$8,344,000
Recreation	$6,963,000
Benefits During Construction	$479,000
Average Annual Benefits:	$15,786,000
Average Annual Costs:	$8,476,700
Benefit-Cost Ratio:	1.86
Net Benefits:	$7,309,300

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[3] Includes reduced maintenance

[4] Includes operation, maintenance, and monitoring

553. <u>Depth-Damage Curves</u>. The NED plan was rerun changing the inundation depth-damage +/- 10 percent. The results are displayed below in Table 55.

Table 55

SENSITIVITY ANALYSES Depth-Damage Curves Change	
Depth-Damage Curves +10%:	
Average Annual Benefits:	
Storm Damage Reduction[3]	$9,338,000
Recreation	$6,963,000
Benefits During Construction	$479,000
Average Annual Benefits:	$16,780,000
Average Annual Costs[4]	$8,476,700
Benefit-Cost Ratio:	1.98
Net Benefits:	$8,303,300
Depth-Damage Curves -10%:	
Average Annual Benefits:	
Storm Damage Reduction	$8,508,000
Recreation	$6,963,000
Benefits During Construction	$479,000
Average Annual Benefits:	$15,950,000
Average Annual Costs:	$8,476,700
Benefit-Cost Ratio:	1.88
Net Benefits:	$7,473,300

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[3] Includes reduced maintenance

[4] Includes operation, maintenance, and monitoring

LOCAL COOPERATION

554. COST APPORTIONMENT. The cost apportionment between Federal and non-Federal total first cost of the selected plan is shown in Table 56. The selected plan has been shown to be economically justified on benefits associated with storm damage reduction. There are no separable recreation features included with this project. Recreation benefits resulting from the selected plan are not required for justification. Therefore, all recreation benefits are assumed to be incidental to the project. In accordance with Section 103 of the Water Resources Development Act of 1986 and appropriate Federal regulations, such as ER 1165-2-130, Federal participation in a project formulated for hurricane and storm damage reduction is 65 percent of the estimated total project first costs, including Lands, Easements, Rights-of-Ways, Relocations and Dredged Material Disposal Areas (LERRD). LERRD fir this project includes the estimated administrative costs related to the obtainment of easements required for project construction ($107,728) and estimated costs for extensions of existing outfall pipes ($787,154). The estimated market value of LERRD provided by non-Federal interests is included in the total project cost, and they shall receive credit for the value of these contributions against the non-Federal cost share.

555. The cost sharing for the selected plan is based on a total first cost of $52,146,000, and does not include interest during construction, which is used only for economic justification purposes.

TABLE 56
COST SHARING FOR THE SELECTED PLAN
(October 1995 price level)

ITEM	COST
INITIAL BEACH REPLENISHMENT AND BULKHEADS	$51,251,000
LANDS, EASEMENTS, RIGHTS-OF-WAY, RELOCATIONS, DISPOSAL AREAS (LERRD) (includes outfall extensions performed by non-Federal sponsor)	$895,000
PERIODIC NOURISHMENT (3 year cycle)	$12,188,000
PROJECT MONITORING (Annualized)	$268,000

PROJECT FEATURE	FEDERAL COST	%	NON-FEDERAL COST	%	TOTAL
Initial Project Costs (Cash Contributions)	$33,313,150		$17,937,850		$51,251,000
LERRD	$0		$895,000		$895,000
Total Initial Project Costs	$33,313,150	65%	$18,832,850	35%	$52,146,000
Periodic Nourishment (50 Years) (includes major replacement costs)	$130,121,000	65%	$70,065,000	35%	$200,186,000
Project Monitoring Costs (50 years)	$8,530,600	65%	$4,593,400	35%	$13,124,000
Ultimate Project Cost (50 Years)	$172,964,750	65%	$93,491,250	35%	$265,456,000
Ultimate Project Cost Rounded (50 years)	$172,965,000	65%	$93,491,000	35%	$265,456,000

556. SPONSOR FINANCING. In accordance with Section 105(a)(1) of WRDA 1986, the Brigantine Inlet to Great Egg Harbor Inlet Feasibility Study was cost shared 50%-50% between the Federal Government and the State of New Jersey. The contributed funds of the local sponsor, the New Jersey Department of Environmental Protection (NJDEP) demonstrates their intent to

support a project for Absecon Island, New Jersey.

557. The State of New Jersey has a stable source of funding for shore protection projects as described in the Introduction of this report. The State has incorporated this project into its forecast of expenditures.

558. PROJECT COOPERATION AGREEMENT. A fully coordinated Project Cooperation Agreement (PCA) package (to include the Sponsor's financing plan) will be prepared subsequent to the approval of the feasibility phase and will reflect the recommendations of this Feasibility Study. NJDEP, the non-Federal sponsor, has indicated support of the recommendations presented in this Feasibility Study and the desire to execute a PCA for the recommended plan. Other non-Federal interests, such as the Cities of Atlantic City, Ventnor and Margate, the Borough of Longport and Atlantic County have indicated their support of the project.

559. In the PCA the non-Federal sponsor will:

- Provide 35 percent of total project costs assigned to hurricane and storm damage reduction, as further specified below:

- Provide all lands, easements, and rights-of-way, including suitable borrow and dredged or excavated material disposal areas, and perform or ensure the performance of all relocations determined by the Federal Government to be necessary for the construction, operation, and maintenance of the Project.

- Provide all improvements required on lands, easements, and rights-of-way to enable the proper disposal of dredged or excavated material associated with the construction, operation, and maintenance of the project. Such improvements may include, but are not necessarily limited to, retaining dikes, wasteweirs, bulkheads, embankments, monitoring features, stilling basins, and dewatering pumps and pipes.

- Provide, during construction, any additional amounts as are necessary to make its total contribution equal to 35 percent of total project costs assigned to hurricane and storm damage reduction.

- For so long as the Project remains authorized, operate, maintain, repair, replace, and rehabilitate the completed Project, or functional portion of the Project, at no cost to the Federal Government, in a manner compatible with the Project's authorized purposes and in accordance with applicable Federal and State laws and regulations and any specific directions prescribed by the Federal Government.

- Give the Federal Government a right to enter, at reasonable times and in a reasonable manner, upon property that the Non-Federal Sponsor, now or hereafter, owns or controls for access to the Project for the purpose of inspection, and, if necessary after failure to perform by the Non-Federal Sponsor, for the purpose of completing, operating, maintaining, repairing, replacing, or rehabilitating the Project. No completion, operation, maintenance, repair, replacement, or rehabilitation by the Federal Government shall operate to relieve the Non-Federal Sponsor of responsibility to meet the Non-Federal Sponsor's obligations, or to preclude the Federal Government from pursuing any other remedy at law or equity to ensure faithful performance.

- Hold and save the United States free from all damages arising from the construction, operation, maintenance, repair, replacement, and rehabilitation of the Project and any Project-related betterments, except for damages due to the fault or negligence of the United States or its contractors.

- Keep, and maintain books, records, documents, and other evidence pertaining to costs and expenses incurred pursuant to the Project in accordance with the standards for financial management systems set forth in the Uniform Administrative Requirements for Grants and Cooperative Agreements to State and Local Governments at 32 Code of Federal Regulations (CFR) Section 33.20.

- Perform, or cause to be performed, any investigations for hazardous substances as are determined necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Public Law (PL) 96-510, as amended, 42 U.S.C. 9601-9675, that may exist in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be required for the construction, operation, and maintenance of the Project. However, for lands that the Federal Government determines to be subject to the navigation servitude, only the Federal Government shall perform such investigations unless the Federal Government provides the Non-Federal Sponsor with prior specific written direction, in which case the Non-Federal Sponsor shall perform such investigations in accordance with such written direction.

- Assume complete financial responsibility, as between the Federal Government and the Non-Federal Sponsor for all necessary cleanup and response costs of any CERCLA regulated materials located in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be necessary for the construction, operation, or maintenance of the Project.

- As between the Federal Government and the Non-Federal Sponsor, the Non-Federal Sponsor shall be considered the operator of the project for the purpose of CERCLA liability. To the maximum extent practicable, operate, maintain, repair, replace and rehabilitate the Project in a manner that will not cause liability to arise under CERCLA.

- Comply with the applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public Law 91-646, as amended by Title IV of the Surface Transportation and Uniform Relocation Assistance Act of 1987 (Public Law 100-17), and the Uniform Regulations contained in 49 CFR Part 24, in acquiring lands, easements, and rights-of-way, required for the construction, operation, and maintenance of the Project, including those necessary for relocations, borrow materials, and dredged or excavated material disposal, and inform all affected persons of applicable benefits, policies, and procedures in connection with said Act.

- Comply with all applicable Federal and State laws and regulations, including, but not limited to, Section 601 of the Civil Rights Act of 1964, Public Law 88-352 (42 U.S.C. 2000d), and Department of Defense Directive 5500.11 issued pursuant thereto, as well as Army Regulation 600-7, entitled "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army".

- Provide 35 percent of that portion of total historic preservation mitigation and data recovery costs attributable to hurricane and storm damage reduction that are in excess of one percent of the total amount authorized to be appropriated for hurricane and storm damage reduction.

- Participate in and comply with applicable Federal flood plain management and flood insurance programs.

- Not less than once each year inform affected interests of the extent of protection afforded by the Project.

- Publicize floodplain information in the area concerned and provide this information to zoning and other regulatory agencies for their use in preventing unwise future development in the flood plain and in adopting such regulations as may be necessary to prevent unwise future development and to ensure compatibility with the protection provided by the Project.

- For so long as the project remains authorized, the Non-Federal Sponsor shall ensure continued conditions of public ownership and use of the shore upon which the amount of Federal participation is based.

- Provide and maintain necessary access roads, parking areas, and other public use facilities, open and available to all on equal terms.

560. In an effort to keep the Sponsor involved and local governments informed, meetings were held throughout the feasibility phase. In addition, newsletters were sent periodically describing the study process for Absecon Island (see Appendix D).

561. Coordination efforts will continue, including coordination of this study with other State and Federal agencies. It is currently anticipated that a public meeting will be held upon approval of this Feasibility Study.

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FINAL
ENVIRONMENTAL IMPACT STATEMENT
BRIGANTINE INLET TO GREAT EGG HARBOR INLET
FEASIBILITY STUDY
ABSECON ISLAND INTERIM STUDY
ATLANTIC COUNTY, NEW JERSEY

AUGUST 1996

The lead agency is the U.S. Army Corps of Engineers, Philadelphia District.

Abstract:

This study evaluates existing conditions and shore protection problems facing the communities on Absecon Island, along the Atlantic Coast of New Jersey. Significant beach and dune erosion has left the island vulnerable to storm damages. Severe storms in recent years have caused a reduction in the overall beach height and width along the study area, which, along with the absence of significant dunes, exposes the communities of Atlantic City, Longport, Ventnor, and Margate to catastrophic damage from ocean flooding and wave attack. The selected plan for storm damage reduction along the ocean front is beach nourishment utilizing sand obtained from 3 offshore borrow areas. Beach nourishment will consist of berm and dune restoration along the ocean frontage of Absecon Island. This plan will require 6.2 million cubic yards of sand for initial beachfill placement with 1,666,000 cubic yards for periodic renourishment every 3 years over a 50 year project life. The proposed beach nourishment will result in a 200 foot wide berm with a top elevation of +8.5 feet NGVD29 in Atlantic City, and a 100 foot wide berm with a top elevation of +8.5 feet NGVD29 in Ventnor, Margate, and Longport. The beachfill will be transitioned from a 200 foot berm to a 100 foot berm between Atlantic City and Ventnor for a distance of 1000 feet. In Margate, Longport, and Ventnor, dunes will also be constructed to a top elevation of +14 feet NGVD29, with a 25 foot top width, and side slopes of 1V:5H. The Atlantic City dune will have a top elevation of +16 feet NGVD29, top width of 25 feet, and side slopes of 1V:5H. The dunes are proposed to be planted with 91 acres of dune grass. The dunes will also contain 63,675 linear feet of sand fence, as well as pedestrian and vehicular access ramps.

The selected plan also includes the construction of two timber sheet-pile bulkheads along the Absecon Inlet frontage. The anchored bulkheads would tie in to the existing bulkhead located along Maine Avenue. The bulkheads would be constructed to a top elevation of +14 feet NGVD29, with pile anchors and tie-backs. A revetment of 3-5 ton rough quarrystone will be constructed to an elevation of +5 feet NGVD29 on the seaward side of the bulkhead.

A Section 404 (b)(1) evaluation has been prepared and is included in this Final Environmental Impact Statement. This evaluation concludes that the proposed action would not result in any significant environmental impacts relative to the areas of concern under Section 404 of the Federal Clean Water Act.

PLEASE SEND YOUR COMMENTS TO
THE DISTRICT ENGINEER BY:

For further information on this
statement, please contact:
Beth Brandreth
Environmental Resources Branch
Telephone: (215) 656-6555

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1.0 SUMMARY

1.1 PURPOSE AND NEED

The purpose and need of this statement is to evaluate the anticipated environmental impacts of the alternatives developed for storm damage reduction on Absecon Island, Atlantic County, New Jersey.

The need to which the U.S. Army Corps of Engineers, Philadelphia District is responding is based on the need to reduce the potential for storm damage to structures and property associated with the communities of Absecon Island, New Jersey.

The principal source of economic damages identified for Absecon Island are storms. Severe storms in recent years have caused a reduction in the overall beach height and width along the study area. This, as well as the absence of significant dunes, exposes Absecon Island to catastrophic damage from ocean flooding and wave attack.

1.2 BACKGROUND

The project location (Figure 1) is a segment of Atlantic Coast beach in southern New Jersey, and is approximately 8 miles in length, extending from Absecon Inlet to Great Egg Harbor Inlet. The study area encompasses Absecon Island, which is located in Atlantic County. Absecon Island contains the four communities of Atlantic City, Ventnor, Margate, and Longport. The beaches in these communities have been subject to erosion by storms, tidal inundation, and wave action. Within these areas, structural damage has occurred through direct wave action, particularly at those locations where at times there is virtually no remaining beach or dune system to protect the structures lining the shore.

Efforts have been made to remedy the problems of beach loss within the project area since the mid 1900's. These have included both numerous studies and actual construction. One early Federal beach erosion control project in the study area included the Atlantic City, NJ project which was adopted as House Document 81-538 in 1954. This project was partially completed before being deauthorized in 1990 by PL 99-662. The completed aspects of this project included the construction of 3727 feet of the Brigantine Jetty, some groin and bulkhead work, and beachfill.

Other studies have been conducted, but never constructed these studies examined widening the beachfront, groin

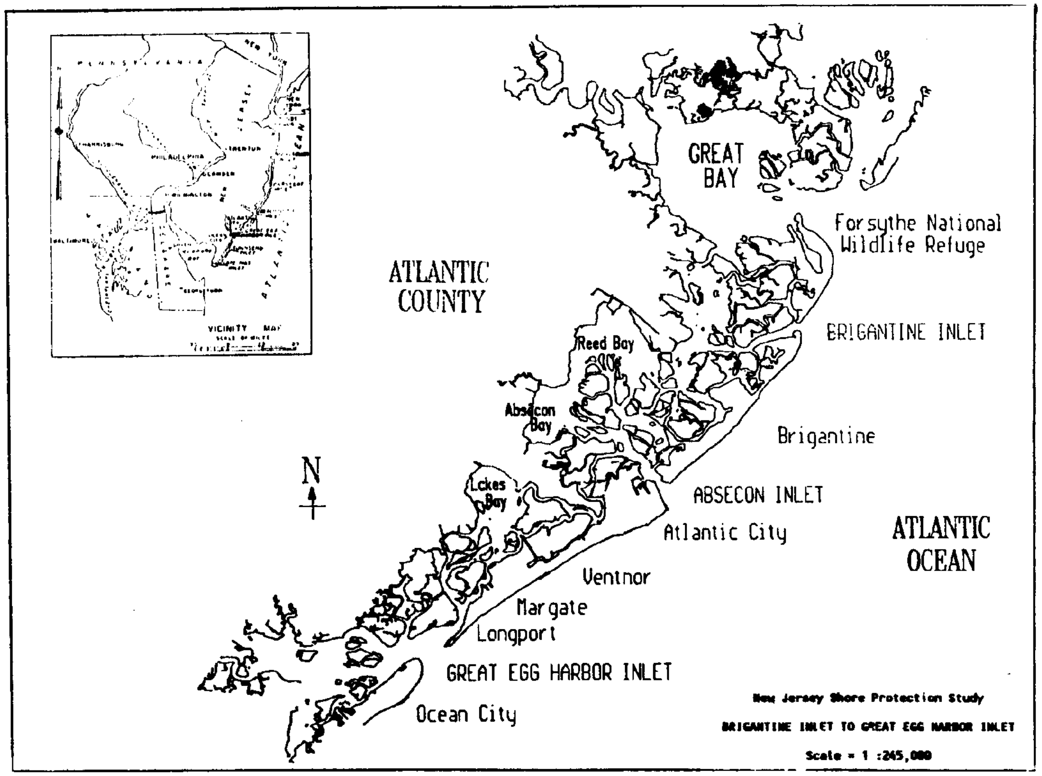


FIGURE 1. Brigantine Inlet to Great Egg Harbor Inlet Study Area

maintenance, dunes, and periodic nourishment. These studies, which were conducted during the time frame of the 1950's through the 1980's, covered the areas of Ventnor, Margate, and Longport, as well as Brigantine Island and Absecon Island. A list of federal activities in the project area is found in Table 1.

In addition to Federal acivities, the NJDEP has been involved in local shore protection along the coast of New Jersey. The Division of Coastal Resources provides technical assistance to citizens and municipalities. Further, it regulates land use through the Coastal Zone Facility Review Act (CFRA), the Wetlands Act, and the Waterfront Development Act.

Since 1985, the NJDEP has initiated several related projects in the study area. Many projects involve dredging of navigation channels and discharging the material on beaches or in back bays. All of the projects under the authority of the State are tailored to address specific small scale problems, and are therefore less expensive than Federal shore protection and navigation projects.

Table 2 describes recent state, municipal, and private projects within the study limits. The dates listed are the dates of permit approval from the U.S. Army Corps of Engineers.

1.3 ALTERNATIVES

A total of 17 structural and three non-structural alternatives have been considered to provide storm damage reduction to the project area. These alternatives were screened based on engineering, socio-economic, and environmental considerations. Excluding the no action alternative, the structural alternatives include seawalls, bulkheads, high profile breakwaters, groins, and beach nourishment. The screening and final optimization concluded that beach nourishment utilizing material dredged from a nearby source should be considered further for the ocean front. Bulkheads were chosen for the inlet frontage. The details of the preferred ocean front plan, the beach nourishment alternative, are as follows: Beach nourishment will consist of berm and dune restoration along the ocean frontage of Absecon Island. This plan will require 6.2 million cubic yards of sand for initial beachfill placement, with 1,666,000 cubic yards for periodic renourishment every 3 years, over a 50 year project life. The proposed beach nourishment will result in a 200 foot wide berm with a top elevation of +8.5 NGVD in Atlantic City, and a 100 foot wide berm with a top elevation of +8.5 NGVD in Ventnor, Margate, and Longport. The beachfill will be transitioned from a 200 foot berm to a 100 foot berm between Atlantic City and Ventnor for a distance of 1000 feet. In Ventnor, Margate, and Longport, dunes will also be constructed to a top elevation of +14 feet NGVD, with a 25 foot top width, and side slopes of 1V:5H. In Atlantic City, the dune will have a

TABLE 1
PRIOR FEDERAL ACTIONS
BRIGANTINE INLET TO GREAT EGG HARBOR INLET

AGENCY	LOCATION	AUTHORIZATION	DESCRIPTION OF PROJECT/STUDY	STATUS
USACE	Brigantine Inlet to Great Egg Harbor Inlet	Senate and House Resolutions December 1987	Shore Protection and Water Quality Study	Reconnaissance Study Report February, 1992
USACE	Coast of New Jersey, Sandy Hook to Cape May	Senate and House Resolutions December 1987	Shore Protection and Water Quality Study	Limited Reconnaissance Study Report September, 1990
USACE	Brigantine Island	HD 94-631 SEC 101a-WRDA 1976 SEC 605-WRDA 1986	Reimburse State for 7 groins Construct new groin Construct dune with fence & grass Raise beach Extend groin Maintain existing groins Periodic nourishment	Preconstruction Planning/Engineering funds never appropriated.
USACE	Absecon Island	HD 94-631 SEC 101a-WRDA 1976 SEC 605-WRDA 1986	Construct weir breakwater for sand bypassing Initial nourishment of beaches Periodic nourishment of beaches	Preconstruction Planning/Engineering funds never appropriated.
USACE	Ventnor, Margate, Longport	PL 86-645. Modified PL 87-874, 1962	Widen beach by placement of fill Maintenance of one existing groin Periodic nourishment	Deauthorized 1 Jan 90 by PL99-662
USACE	Atlantic City	HD 81-538 of 1954 HD 88-325 of 1962	Inlet frontage seawall New groins and extensions Beachfill and Periodic nourishment	Deauthorized 1 Jan 90 by PL99-662
USACE	Absecon Inlet Clam Creek	HD 67-375 of 1922 HD 76-504 of 1946	Provide entrance channel	Completed 1957; Last maintenance dredging 1978 Clam Creek dredged 1983

TABLE 7
PRIOR NON-FEDERAL PROJECTS
ABSECON INLET TO GREAT EGG HARBOR INLET

AGENCY	COASTAL AREA	LOCATION	NATURE OF PROJECT	DATE OF REGULATORY APPROVAL
NJDEP	Absecon Inlet	Absecon Inlet/Atlantic Ocean	Dredging	04/11/85
NJDEP	Absecon	Absecon Creek & Absecon Bay	Maintenance Dredge	12/03/87
NJDEP	Atlantic City	Oriental Avenue - Arkansas	Beach Nourishment	04/01/86
NJDEP	Longport	11th to 25th Avenue	Dredge Great Egg Harbor Inlet. Place sand on Longport beaches.	05/22/90
NJDEP	Longport	11th to Atlantic	Stone Revetment	09/24/93
Municipal	Atlantic City	Atlantic to Madison and Melrose to Caspian	Bulkhead reconstruction with riprap toe protection	1993
Municipal	Longport	Vicinity of 17th Street	Stone revetment along Risley Channel	N/A
Private	Atlantic City	Clam Creek	Dredging	05/09/88
Private	Atlantic City	Clam Creek & 801 N. Maryland Avenue	Dredging	12/29/89
Private	Atlantic City	Beach Thorofare along 2923 Sunset Avenue	Dredge and construct bulkhead.	10/09/85
Private	Atlantic City	Clam Creek at Huron, MD and RI Avenues	Dredging	01/11/88
Private	Atlantic City	Gardener's Basin at 320 N. RI Avenue	Replace bulkhead and fill.	12/29/87
Private	Atlantic City	Missouri Ave. Generating Station	Construction of bulkhead & revetment.	07/24/91
Private	Atlantic City	Beach Thorofare	Wooden pier and riprap	05/21/90
Private	Margate	Beach Thorofare & Amherst Ave.	Dredge & construct marina	01/19/88
Private	Margate	Beach Thorofare & Amherst Ave.	Dredge & construct marina	02/05/91
Private	Ventnor	Block 157, Lot 17	Reconstruct marina. Increase boat slips.	04/12/90
Private	Ventnor	West Canal, 714 North Harvard Ave.	Construct piers, moorings, and maintenance dredge.	06/28/90
Private	Ventnor	West Canal & IWW, North Harvard Ave.	Dredge and construct piers.	06/13/88

top elevation of +16 feet NGVD29, a 25 foot top width, and side slopes of 1V:5H. The dunes are proposed to be planted with 91 acres of dune grass. The dune will also contain 63,675 linear feet of sand fence, as well as 170 pedestrian and 10 vehicular crossovers.

The preferred plan for the project area also consists of the construction of a timber sheet-pile bulkhead in two separate sections along approximately 1,050 feet of the Absecon Inlet frontage. The anchored timber sheet-pile bulkhead would tie in to the existing bulkhead constructed along Maine Avenue at both locations. From Atlantic to Oriental Avenues, the bulkhead would be located at the seaward edge of the existing boardwalk. Both sections of bulkhead would be constructed to a top elevation of +14 NGVD29, with pile anchors and tie-backs. A revetment of 3-5 ton rough quarrystone will be constructed to an elevation of +5 NGVD29 on the seaward side of the bulkhead. This bulkhead would prevent damages from inundation and wave attack.

1.4 MAJOR CONCLUSIONS AND FINDINGS

Beach nourishment represents the least environmentally damaging structural method of reducing potential storm damages at a reasonable cost. It is socially acceptable, and proven to work in high energy environments. The somewhat transient nature of beach nourishment is actually advantageous. Beach fill is dynamic, and adjusts to changing conditions until equilibrium can again be achieved. Despite being structurally flexible, the created beach can effectively dissipate high storm energies, although at its own expense. Costly rigid structures like seawalls and breakwaters utilize massive amounts of material foreign to the existing environment to absorb the force of waves. Beach nourishment uses material typical of adjacent areas, sand, to buffer the shoreline structures against storm damage. Consequently, beach nourishment is more aesthetically pleasing as it represents the smallest departure from existing conditions in a visual and physical sense, unlike groins. When the protective beach is totally dispersed by wave action, the original beach remains. On the other hand, bulkheads, seawalls, and revetments may lead instead to eventual loss of beach as the end of their project life is approached.

Some of the suggested non-structural storm damage reduction alternatives are currently practiced, such as flood insurance and development regulation. Consequently, implementation is somewhat a moot point. Others such as land acquisition are prohibitively expensive, and are socially unacceptable in any event.

1.5 AREAS OF CONCERN

A project of this nature will have temporary adverse impacts on water quality and aquatic organisms. Dredging will increase suspended solids and turbidity at the point of dredging and at the discharge (beachfill) site. The area to be dredged and the area where the material will be deposited will be subject to extreme disturbance. Many existing benthic organisms will become smothered at the beachfill site. Dredging will result in the temporary complete loss of the benthic community in the borrow area. These disruptions are expected to be of short-duration and of minor significance if rapid recolonization by the benthic community occurs. Dredging will consequently temporarily displace a food source for some finfish.

Absecon Inlet, Great Egg Harbor Inlet, and the offshore area, where the propsed borrow areas are located, has historically been a productive surf clam (Spisula solidissima) fishery. Recent surveys conducted within the proposed borrow areas indicate that these areas are still suitable for surf clam harvesting. Dredging in these areas has the potential to remove the harvestable clams. In addition, periodic maintenance disturbances subsequent to the initial dredging may have adverse effects on any potential recovery of the surf clam population. Where ever possible, measures will be taken to minimize the impacts to the surf clam population within the borrow areas. These measures may include the commercial harvesting of clams prior to dredging, only dredging in approved sections of the borrow areas, and limiting the number of sites used for renourishment activities. These and any other measures will be fully coordinated with appropriate state and local resource agencies.

Concerns regarding the use of a hopper dredge and its potential impact on Federally listed threatened and endangered sea turtles were raised with respect to this project. A biological assessment, pursuant to Section 7 of the Endangered Species Act, is currently being reviewed by the National Marine Fisheries Service (NMFS). This assessment covers all Philadelphia District dredging projects that may have an impact on threatened and endangered marine species. Until a final biological opinion is received from NMFS, the Philadelphia District will continue the measures used in the past to reduce the likelihood of negatively impacting marine species. These measures may include the use of NMFS approved turtle monitors, dragarm deflectors on the dredge, and timing the dredging when sea turtles are known to be absent in the borrow area. These and any other measures will be fully coordinated with NMFS prior to dredging.

Concern over the impact of a beachfill operation on the State and Federally threatened piping plover has been raised with

regard to this project. Piping plovers generally nest between April and August on sparsely vegetated, sandy beaches in New Jersey. While plovers have been known to nest on the southern tip of Brigantine Island, no nesting pairs have been observed on Absecon Island. If a nesting pair(s) should appear within the project impact area prior to or during the initial beachfill and subsequent periodic beach nourishments, appropriate measures to avoid adversely impacting these and other threatened or endangered birds will be implemented. Mitigative measures will be coordinated with the U.S. Fish and Wildlife Service and the New Jersey Department of Environmental Protection (NJDEP), Division of Fish, Game and Wildlife. These measures may include the establishment of buffer zones around discovered nests, and conducting beachfill operations around the buffer zone until nesting is completed.

1.6 ENVIRONMENTAL STATUTES AND REQUIREMENTS

Preparation of this Final Environmental Impact Statement (FEIS) has included coordination with appropriate Federal and State resource agencies. With the public review of the DEIS, a Water Quality Certificate, in accordance with Section 401 of the Clean Water Act, and a concurrence of Federal consistency with the New Jersey Coastal Zone Management program, in accordance with Section 307(c) of the Coastal Zone Management Act, was requested from the New Jersey Department of Environmental Protection (NJDEP). NJDEP has responded to this request and coordination is currently taking place to resolve their concerns regarding the project. The Corps feels that mutually agreeable solutions will result from this coordination and that a Water Quality Certificate and Coastal Zone consistency will be forthcoming. The Comment/Response Appendix of this report contains the comment letter from NJDEP as well as the Corps responses to their concerns. A Section 404(b) (1) evaluation has been prepared and is included as Section 7 of the FEIS. This evaluation concludes that the proposed action would not result in any significant environmental impacts relative to the areas of concern under Section 404 of the Clean Water Act. In accordance with the Fish and Wildlife Coordination Act (FWCA), planning aid reports were obtained and are provided in the Pertinent Correspondence Appendix in the main report. A section 2(b) FWCA report was obtained, based on information presented in the DEIS. The section 2(b) report can be found in the Comment/Response Appendix in the main report.

Compliance was met for all environmental quality statutes and environmental review requirements except the Clean Water Act and Coastal Zone Management Act. Coordination is continuing with the NJDEP regarding these Acts and compliance certification is expected. Table 3 provides a list of Federal environmental quality statutes applicable to this statement, and their

Table 3. Compliance with Environmental Quality Protection Statutes and Other Environmental Review Requirements at the Present Phase of the Project.

Federal Statutes	Compliance w/Proposed Plan
Archeological - Resources Protection Act of 1979, as amended	Full
Clean Air Act, as amended	Full
Clean Water Act of 1977	Conditional
Coastal Zone Management Act of 1972, as amended	Conditional
Endangered Species Act of 1973, as amended	Full
Estuary Protection Act	Full
Federal Water Project Recreation Act, as amended	N/A
Fish and Wildlife Coordination Act	Full
Land and Water Conservation Fund Act, as amended	N/A
Marine Protection, Research and Sanctuaries Act	Full
National Historic Preservation Act of 1966, as amended	Full
National Environmental Policy Act, as amended	Full
Rivers and Harbors Act	Full
Watershed Protection and Flood Prevention Act	N/A
Wild and Scenic River Act	N/A
Coastal Barrier Resources Act	N/A

Table 3. Compliance with Environmental Quality Protection Statutes and Other Environmental Review Requirements (concluded)

Executive Orders, Memorandum, etc.	
EO 11988, Floodplain Management	Full
EO 11990, Protection of Wetlands	Full
EO 12114 Environmental Effects of Major Federal Actions	Full

Full Compliance - Requirements of the statute, EO, or other environmental requirements are met for the current stage of review.

Conditional Compliance - NJDEP has issued a conditional compliance for the project based on the resolution of items discussed in their August 26, 1996 letter (See first page of comment/response appendix).

Noncompliance - None of the requirements of the statute, EO, or other policy and related regulations have been met.

N/A - Statute, EO, or other policy and related regulations are not applicable.

Ongoing - Coordination is continuing.

compliance status relative to the current stage of project review.

2.0 NEED FOR AND OBJECTIVE OF ACTION

2.1 NEED

The proposed action is based on a need for storm damage reduction which would benefit the communities on Absecon Island. The need for storm damage reduction action is based on storm damage vulnerability with a high potential for storm-induced erosion, inundation and wave attack, which is exacerbated by long term shoreline erosion.

The principal problems identified along Absecon Island are progressive beach erosion due to long-term shore processes, and the threat of storm damage. This reach of the New Jersey shoreline was one of the earliest to be developed, and therefore has been subject to storm damages for a long time. The Longport seawall was built in 1917 after the loss of the southernmost ten blocks of the community. Strides have been made in some areas to minimize losses associated with storm damage. Such advances include building code improvements, dune ordinances and building restrictions. Many portions of the developed coast will remain vulnerable however, due to the proximity of structures to the beach and the level of development.

Progressive and constant erosion is evident in certain areas of the coastline. This erosion slowly narrows the protective beach width. Atlantic City's northern shoulder has long term erosion rates of between 2.5 and 7 feet per year.

It should be noted that simply because areas may have relatively stable or low background erosion rates does not preclude the need to fully address options for additional shore protection. Ventnor and Margate have relatively wide beaches in some areas but the dunes are small and discontinuous. Nor does a stable historic erosion rate mean that over the course of several years shoreline positions and elevations do not vary greatly. For example Longport, which has a relatively stable shoreline position due to its seawall, lost a great deal of beach elevation during the recent storms of 1991 and 1992. A lower beach elevation will allow larger waves to impact the oceanfront. The beach elevation regained in subsequent years, presumably concurrent with a loss of sand in the northern beaches. Presently, much of the existing beachfront in Longport lacks an adequate dune system and the berm width is zero in front of the seawall.

The principal cause of economic damages identified along the Atlantic coast of New Jersey is storms. An accurate assessment of storm damages, delineated by causal mechanism, is difficult to develop for coastal storms. Along the study area, records of historic storm damages are poor except for the 1962 Northeaster, the coastal storm of 1984 and the December 1992 storm. The years 1991-1992 brought three significant storms to the study area. A summary of existing storm damage information for the study area is presented in Table 4.

Over the years, erosion and storm activity have seriously reduced the ability of the shoreline in the project area to provide adequate storm damage protection for Absecon Island. Continuation of this historic trend will increase the potential for economic losses, and the threat to human life and safety.

2.2 OBJECTIVES

Planning objectives were identified based on problems, needs and opportunities, as well as existing physical and environmental conditions present in the study area.

In general, the prime Federal objective is to contribute to the National Economic Development (NED) account consistent with protecting the Nation's environment. Both of these objectives must be consistent with national legal statutes, applicable executive orders, and other Federal planning requirements. The general and specific planning objectives for the Absecon Island Interim Feasibility Study take an integrated systematic approach to the solution of the erosion and inundation problems associated with coastal storms on Absecon Island. Accordingly, the following general and specific objectives have been identified.

General:

- Meet the specified needs and concerns of the general public.
- Respond to expressed public desires and preferences.
- Be flexible to accommodate changing economic, social and environmental patterns and changing technologies.
- Integrate with and be complementary to other related programs in the study area.
- Be implementable with respect to financial and institutional capabilities and public support.

Specific:

- Reduce the threat of potential future damages due to the effects of storms, with an emphasis on inundation and recession of the shoreline.

TABLE 4

HISTORIC STORM DAMAGE DATA

DATE	DAMAGES	NOTES
9/1889	$50,000 (1889 $)	Heinz Pier, Atlantic City
10/1896	$33,000 (1896 $)	Atlantic City
9/38	$70,000 (1938 $)	Brigantine to Atlantic City
9/44	$5,000,000 (1944 $)	Atlantic City; 62% attributable to wave damage.
	$1,000,000 (1944 $)	Ventnor, Margate, Longport
11/50	$564,000 (1950$)	Absecon Island
	$100,000 (1950$)	Longport
3/62	$21,634,700 (1962 $)	Absecon Island; 10% attributable to wave action
3/84	$1,450,325 (1984 $)	Atlantic County
10/91	$13,000,000	Atlantic County (initial amount claimed by County)
1/92	$2,650,000	Absecon Island (NJDEP estimate to repair beaches only)
12/92	$1,183,854	Atlantic City
	$ 259,405	Ventnor
	$ 437,070	Margate
	$ 125,199	Longport
	$2,600,000	Atlantic County (FEMA Qualified Damage)

- **Mitigate the effects of, or prevent, the long-term erosion that is now being experienced.**

- In accordance with the limits of institutional participation, all plan components must maximize NED benefits.

- Enhance the recreational potential of the area as an incidental benefit.

- Where possible, preserve and maintain the environmental character of the areas under study, including such considerations as aesthetic, environmental and social concerns, as directly related to plans formulated for implementation by the Corps.

2.3 PROJECT AUTHORITY

The Brigantine Inlet to Great Egg Harbor Inlet Feasibility Study was authorized by resolutions adopted by the Committee on Public Works and Transportation of the U.S. House of Representatives and the Committee on Environment and Public Works of the U. S. Senate in December 1987.

The Senate resolution adopted by the Committee on Environment and Pubic Works on December 17, 1987 states:

> "That the Board of Engineers for Rivers and Harbors, created under Section 3 of the Rivers and Harbors Act, approved June 13, 1902, be, and is hearby requested to review existing reports of the Chief of Engineers for the entire coast of New Jersey with a view to study, in cooperation with the State of New Jersey, its political subdivisions and agencies and instrumentalities thereof, the changing coastal processes along the coast of New Jersey. Included in this study will be the development of a physical, environmental, and engineering database on coastal area changes and processes, including appropriate monitoring, as the basis for actions and programs to prevent the harmful effects of shoreline erosion and storm damage; and, in cooperation with the Environmental Protection Agency and other Federal agencies as appropriate, develop recommendations for actions and solutions needed to preclude further water quality degradation and coastal pollution from existing and anticipated uses of coastal waters affecting the New Jersey Coast. Site specific studies for beach erosion control, hurricane protection, and related purposes should be

> undertaken in areas identified as having potential for a Federal project, action, or response".

The House resolution adopted by the Committee on Public Works and Transportation on December 10, 1987 states:

> "That the Board of Engineers for Rivers and Harbors is hearby requested to review existing reports for the Chief of Engineers for the entire coast of New Jersey with a view to study, in cooperation with the State of New Jersey, its political subdivisions and agencies and instrumentalities thereof, the changing coastal processes along the coast of New Jersey. Included in this study will be the development of physical, environmental, and engineering database on coastal area changes and processes, including appropriate monitoring, as the basis for actions and programs to prevent the harmful effects of shoreline erosion and storm damage; and, in cooperation with the Environmental Protection Agency and other Federal agencies as appropriate, the development of recommendations for actions and solutions needed to preclude further water quality degradation and coastal pollution form existing and anticipated uses of coastal waters affecting the New Jersey Coast. Site specific studies for beach erosion control, hurricane protection, and related purposes should be undertaken in areas identified as having potential for a Federal project, action, or response which is engineeringly, economically, and environmentally feasible".

2.4 PUBLIC CONCERNS

Initial discussions with local, State, and Federal agencies produced the following concerns that were either environmental or socio-economic in nature.

The non-Federal sponsor for this Feasibility study is the New Jersey Department of Environmental Protection (NJDEP). Currently, NJDEP's concern, within the scope of this interim feasibility study, is with shore protection problems on Absecon Island. The State is interested in a long-term Federal shore protection project due to funding constraints, which prohibit the State and local governments from carrying out a long term shore protection program on their own.

Selection of a sand borrow area(s) was a primary environmental concern raised for this project. Issues involved

with borrow area selection included the presence/absence of significant cultural resources, benthic resources, surf clam stocks, fisheries impacts, threatened and endangered species, water quality impacts, and sand grain compatibilities with beach material. Some of these issues required further investigation and are discussed in later sections of this FEIS.

3.0 ALTERNATIVES

3.1 SCREENING OF ALTERNATIVES

3.1.1 Structural Storm Damage Reduction Alternatives

3.1.1.1 Bulkheads

The bulkheads protecting Absecon Island, both along the inlet and the ocean front, are constructed of timber and concrete, and conditions vary from excellent to poor. The top elevation of the bulkheads vary between +10 to +15.5 feet MLW along the Absecon Inlet frontage, where there are two different sections of bulkhead. The new anchored bulkhead along Maine Avenue from Caspian Avenue to Atlantic Avenue (2200 feet in length), was constructed in 1993 and is in excellent condition. The remaining sections from Atlantic to Euclid Avenues (300 feet in length), and those from Seaside to Metropolitan Avenues (approximately 1000 feet in length), were constructed in 1935 and are in very poor condition. The section from Seaside to Metropolitan is buried under sand, and is discontinuous in many areas.

In Ventnor, all timber and concrete bulkheads were constructed by private interests. There is 5300 feet of concrete bulkhead and 3400 feet of timber bulkhead in the city of Ventnor. All the concrete bulkheads were constructed between 1925 and 1935, top elevations vary between +12 to +13 feet MLW, top widths vary between 2 and 3 feet, and conditions range from poor to good. All the concrete bulkheads are mostly intact and continue to provide protection to beachfront properties and street ends. The timber bulkheads in Ventnor were constructed between 1950 and 1952, with approximately 500 feet being replaced following the March 1962 storm.

In Margate, the entire shorefront (8450 feet) is protected by timber bulkheads, which were built between 1957 and 1964. The newest sections of bulkhead at Granville and Rumson Avenues were replaced in 1993. Top elevations vary between +10 and +13 feet MLW, and the majority are in fair to good condition.

In Longport, most of the ocean front is protected by either timber bulkhead or curved-face concrete seawall. There is also 55 feet of steel sheet pile bulkhead at the seaward end of

28th Avenue which is in poor condition with significant corrosion. The timber bulkheads vary in top elevation from +10 to +14 feet MLW and the majority are in fair to good condition. The most recent section replaced was at 30th Avenue and the property just north of 30th, in 1984. The sections at Pelham, Manor, and 31st Avenues are scheduled to be replaced in the near future by the State and municipality.

Bulkheads serve the purpose of stabilizing the upland behind them, as well as protecting the upland against wave action. Bulkheads can be characterized as an erosion control measure not designed to stand up to direct wave attack in ocean exposed locations. They do not provide a long-term solution, because a more substantial wall is required as the beach continues to recede, and larger waves reach the structure. In addition, vertical bulkheads can suffer from severe scouring when toe protection is not provided.

3.1.1.2 Seawalls

This alternative includes the construction of a "Longport type" curved face seawall placed along the entire project length, replacing all existing discontinuous and dilapidated bulkheads. This structure includes stone toe protection, is pile supported, and provided with underlying sheeting to reduce underseepage. This alternative would not provide any recreational beach restoration, but would provide storm damage protection consistent with other structural alternatives. The major problem with this alternative is its expense.

Seawalls may retain a low fill, but their primary purpose is to withstand, and to deflect or dissipate, wave energy on an ocean shoreline. Cost of construction would be prohibitively high with values of thousands of dollars per linear foot, depending on the size and construction material used. Because seawalls protect only the land immediately behind them, maintenance of a beach would be difficult. Also, scouring in front of the seawall and increased erosion can be expected during storms due to the reflection of waves. Widening and maintenance of the beach in front of the structure would be necessary to reduce scour, and to continue recreational use of the shoreline.

Currently, approximately 3300 feet of concrete seawall exists in the Longport section of the study area. The seawall is a combination curved face and stepped structure, which was originally built in 1917 and rehabilitated in 1981, at which time the curved face was repaired and the top elevation was raised to +11.6 feet MLW. The seawall is in fair to good condition, with some minor cracking and spalling. The structure has remained stable since 1963, and has been effective in providing protection to the properties behind it.

3.1.1.3 Revetments

There are three stone revetments providing erosion protection for bulkheads and seawalls on Absecon Island. There is a new stone revetment along the length of the new timber bulkhead at Maine Avenue on the Absecon Inlet frontage. There is also a stone revetment providing erosion protection along the length of the combination curved face and stepped reinforced concrete seawall in the city of Longport. Top elevation of the revetment varies between +6 to +6.3 feet MLW, and has concrete void filler in the upper 18 inches of stone. It is in fair to good condition.

There is a new stone revetment in the city of Longport at 11th Avenue, extending to the inner end of the stone groin constructed at Atlantic Avenue. The crest of the revetment was constructed with a top width of 14 feet, a top elevation of +8.0 feet MLW, using 8 to 9 ton weight rough quarrystone. The revetment fronts an existing timber bulkhead with a top elevation varying between +10.0 and +12.0 feet MLW, and replaces a previous concrete block and stone revetment. The revetment was constructed by the State of New Jersey in 1993.

Revetments are also similar in nature and construction to seawalls, however, they are typically sloped structures along a beach, dune, or bluff. Revetments, like seawalls, are designed to stand up to and dissipate wave energy. Revetments depend on the underlying soil for support; therefore, there is a vulnerability to damage and failure due to undermining.

3.1.1.4 Offshore Breakwater

Breakwaters have the effect of reducing wave action and acting as a littoral barrier that tends to build the shoreline leeward of them. Offshore breakwaters can range from floating tire or inflated structures placed in shallow water, to massive stone structures founded in relatively deep water. Particular care must be taken in the design and location of the structure, as erosion of the downdrift beach can occur if the structure is placed too near the shore, thus cutting off some of the littoral drift. Gaps or breaks in the structure must also be permitted to prevent the development of undesirable hydraulic currents between the ends of the structures, and to maintain water quality inshore of the structure. To be of material benefit, such a structure would have to be as long as the shoreline that is protected. Some advantages of breakwaters are that they provide protection without impairing the usefulness of the beach, and they have a relatively low maintenance cost and long project life. Some disadvantages are high construction costs, a potential navigation hazard, and a potential for starvation and erosion of downdrift beaches. Moreover, the reduction of wave action may have a negative impact on the attractiveness of the recreational beach.

3.1.1.5 Groins

There are currently eight (8) groins, approximately 500 feet apart, in Atlantic City along the Absecon Inlet frontage. Two timber groins were constructed by the city and State in 1930-32, and repaired and protected with stone ends in 1958. Five stone groins, and one timber and stone groin, were also constructed along the inlet by the city and State between 1946 and 1958. Also along the inlet in Atlantic City is the Oriental Avenue jetty. It was built by the Federal Government in 1946-48, extended in 1961-62 to its present length, and rehabilitated by the State in 1983. All eight inlet groins and the jetty are in good condition.

Along the ocean coast of Absecon Island, there are a total of twenty-nine (29) beach groins. Nine are stone groins that are in good to fair condition, with little or negligible displacement or loss of stone along their visible length. Several of the stone groins in Atlantic City were rehabilitated by the city and the State in 1983. Eleven beach groins are constructed of timber that are in fair to poor condition, many with rotting timbers which render them permeable. There are nine groins constructed of stone and timber cribbing that are in poor condition, with all but a few cases existing in a state of debris, nearly invisible. These do not appear to serve their original function, and similar structures have not been constructed since the late 1920's.

Groins are long, narrow structures, constructed perpendicular to the shoreline for the purpose of building or stabilizing the beach by trapping littoral material, or retaining artificially placed beachfill. In order for a system of groins to be effective, there must exist an adequate longshore movement of sand, and groins must be designed consistent with beach profiles. Otherwise downdrift groin compartments may not fill properly, and periodic artificial filling of groin compartments may be required. Groins, if not filled initially, tend to accumulate material on the updrift side, with a corresponding erosion of material on the downdrift side. The resulting irregularly shaped shoreline, together with the presence of the groin structures themselves, make groin-protected shorelines aesthetically displeasing to some individuals.

3.1.1.6 Beach Nourishment

Beach nourishment is moderate in cost in comparison to other structural alternatives, and directly solves the main erosion problem in the area, a deficiency of sand on the beach. An increase in beach area has an added benefit as a recreational feature, as well as aesthetically improving the appearance of the shoreline. In addition, a beach maintained in adequate dimensions has value as a protective measure because beaches are very effective in dissipating wave energy. An important feature of a successful and moderately priced beach nourishment project is to find a suitable borrow area, both in terms of the amount and grain size of the material to be used. A large enough dune height and berm width could provide a solution to all of the erosion and storm protection problems of the study area, but the cost to maintain an adequate berm width could be high.

3.1.1.7 Perched Beach

This alternative provides protection similar to beach restoration with an offshore breakwater. The difference is the addition of a submerged stone rubble mound structure, which is used to support the offshore end of the placed beachfill, thus eliminating the outer part of beach profile near its closure with the ocean bottom. Therefore, the actual amount of fill material to be placed is less than in a typical beachfill. The submerged rubble mound structure acts in the same way as the natural bar formed offshore during storm events, creating a "perched beach" with a wider berm. The main problem with this alternaitive is that the angled swell scours in front of, and behind the offshore structure, resulting in the need for heavy maintenance. In addition, any interception of littoral drift will cause erosion downcoast, even if only temporarily. Due to the expense caused by high maintenance with reclamation, this alternative was not considered further as part of the selected plan.

3.1.1.8 Submerged Reef With Beachfill

Another sand retention alternative, this alternative involves the use of interlocking concrete units which form an offshore reef. This reef is intended to dissipate incident wave energy during storms, and to prevent outgoing currents from carrying sand to deeper water. Experience to date with this alternative along the New Jersey shore does not indicate that it is cost effective.

3.1.1.9 Offshore Submerged Feeder Berm

Potentially high costs associated with onshore sand placement of sand have led to the development of alternate less expensive methods of beach nourishment. One such method is nearshore berm placement. In some areas, nearshore berms can reduce wave damage and provide sand to the littoral system with a cost as little as half that of onshore placement (Allison and Pollock, 1993 and McLellan et. al, 1990).

Because nearshore sand placement has not been successful in the past, and current design techniques are limited, nearshore placement is a higher risk option than direct onshore placement at Absecon Island. Also, because nourishment areas are located adjacent to potential borrow sources, the difference in cost between direct onshore and nearshore placement may not be significant.

3.1.2 Non-Structural Storm Damage Reduction Alternatives

3.1.2.1 Flood Insurance

Flood Insurance provides compensation for damages through annual premiums which are based on the risk involved. The National Flood Insurance Program encourages local governments to adopt sound flood plain management programs designed to reduce future flood losses.

In order to provide a national standard without regional discrimination, the 100-year flood has been adopted by the Federal Emergency Management Agency (FEMA) as the base flood for purposes of flood plain management.

The Corps has established the 3-foot breaking wave as the criterion for identifying coastal high hazard zones. (See U.S. Army Corps of Engineers, Galveston District, Guidelines for Identifying Coastal High Hazard Zones, Galveston, Texas, June 1975.) These high energy wave zones, known as V zones, require much more stringent flood plain management measures, such as elevating structures on piles or piers.

The most recent studies completed by FEMA for the Cities of Atlantic City (15 February 1983), Margate City (18 April 1983), Ventnor (15 March 1983) and the Borough of Longport (15 February 1983) divided the coastal portions of the towns of Absecon Island into three zones:

> Zones V - Special Flood Hazard Areas along coasts inundated by the 100-year flood as determined by detailed methods, and that have additional hazards due to velocity (wave action); base flood elevations shown and flood hazard factors determined;
>
> Zones A - Special Flood Hazard Areas inundated by the 100-year flood; base flood elevations and flood hazards factors determined; and
>
> Zone B - Areas between limits of the 100-year flood and 500-year flood: or certain areas subject to 100-year flooding with average depths less than (1) one foot, or where the contributing drainage area is less than one square mile.

It should be noted that during the updated and detailed feasibility study, wave and inundation extent due to a 100 year storm event can vary considerably, when compared to the V zones delineated in the Federal Insurance Rate Maps (FIRMs).

Atlantic City is made up of three zones, V, A and B. The V zone generally extends along the coast and reaches landward, where it meets the coastal bulkheads and seawalls associated with the boardwalk from Jackson Avenue through Maine Avenue. The V zone continues parallel to Maine Avenue extending into the bay side of Atlantic City. Beyond the V zone the area becomes an A zone with the exception of a few B zone pockets, which occur between Jackson and Providence Avenues (approximately 400-800 feet wide), and also between Mission and Kentucky, and Tennessee and Virginia Avenues, 800 to 1000 feet landward of the boardwalk.

Longport's corporate limits have been designated as containing both V and A zones. The V zone generally ends at the beginning of the seawall. At the southeastern portion of Longport the V zone is within 40 to 80 feet of Beach Terrace. Gradually it recedes, and at 22nd and Atlantic Avenues it is approximately 240 feet seaward. At 32nd thru 36th Avenues the V zone fluctuates, but on average is 160 feet seaward of Atlantic Avenue. The flood zone beyond the V zone is designated A zone, which encompasses the rest of the borough.

In Margate, the V zone extends landward to the coastal bulkhead and slightly beyond in some areas. Generally the V zone is 400 feet east of Atlantic Avenue between Huntington and Cedargrove Avenues, the central coastline of Margate. The V zone edges closer to Atlantic Avenue north and south of this central area. There is an abrupt drop to a B zone near the northern corporate limits at Brunswick Avenue. The remainder of Margate is designated Zone A.

Ventnor also contains V, A and B zones. The V zone extends just beyond the boardwalk at points north from New Haven Avenue to the Ventnor City corporate limits. The bulkhead area where the V zone ends is 400 to 480 feet seaward of Atlantic Avenue. South of New Haven Avenue the V zone extends beyond the boardwalk approximately 40 to 160 feet, and continues to the southern limits of Ventnor. Beyond the V zone, the A zone begins. The A zone is quite narrow (40 to 80 feet) south of Derby Place. North of Derby Place, the A zone widens from approximately 40 to 120 feet. The A zone drops to a B zone, which extends north to south for the entire corporate limits, with a width of 800 feet. Beyond the B zone, the area reverts back to an A zone designation.

3.1.2.2 Development Regulations

This includes such non-structural measures as zoning, building codes, and bulkhead ordinances. Property owners who wish to develop or rehabilitate structures in the cities of Atlantic City, Margate, Ventnor or the Borough of Longport must first receive the proper permits from the New Jersey Department of Environmental Protection (NJDEP). NJDEP helps the applicant arrange meetings with appropriate State officials as well as answer any questions on permit requirements.

The Basic Building Code of the Building Officials and Code Administrators International, Inc. (BOCA) has been adopted as a Uniform Construction Code (N.J.S.A. 52:27D-1 et seq.) and is required for use by all municipalities in New Jersey. Flood proofing requirements were made part of the code in 1984. The flood proofing section of the code (Section 1313) applies to all new structures located in flood prone areas, and to those structures where damage or cost of reconstruction or restoration is in excess of 50% of its replacement value. Flood prone areas are defined using the 100 year base flood as the minimum criterion. The code requires that all buildings and structures located within a flood prone area have the lowest structural member, except pilings and columns, at or above the base flood level. The flood proofing requirements of the code in coastal high hazard areas ("V" Zone) pertain to anchoring of buildings and structures to piles and columns, fastening of building components, and placement of obstructions below the lowest floor. Pile foundations are either constructied of wood, concrete or steel columns driven into the soil. The BOCA code requires pilings to be used in the foundation of buildings for certain soil types, not proximity to the ocean as might be supposed.

Rules on Coastal Zone Management, N.J.A.C. 7:7E as amended July 18, 1994, also regard areas within 24 feet of oceanfront shore protection structures, which are subject to wave run-up and overtopping as part of High Hazard Areas. The Coastal High Hazard Area extends from offshore to the inland limit of a primary frontal dune along an open coast. V zones on many Federal Insurance Rate Maps (FIRMs) have landward limits in high hazard areas delineated by oceanfront bulkheads, revetments or seawalls, which are typical of the conditions for this study area.

Residential development, including hotels and motels is prohibited in coastal high hazard areas, except for single family and duplex infill developments, which are conditionally acceptable provided that the standards of New Jersey's coastal zone acts are met.

Generally, commercial development is discouraged in coastal high hazard areas. Some commercial development on the beach is conditionally acceptable within V zone areas provided the area already is densely developed, the site is landward of the boardwalk, the building size meets specific requirements, the facility is open to the general public and supports beach /tourism related activities, and the facility complies with all the flood proofing requirements stated in Rule on Coastal Zone Management N.J.A.C. 7:7E.

Development regulations are an effective means of controlling unwise development in coastal areas. Unfortunately, development regulations cannot prevent storm damages to existing structures within the project area.

3.1.2.3 Evacuation From Areas Subject to Erosion and Storm Damage

Permanent evacuation of existing developed areas subject to inundation involves the acquisition of lands and structures, either by purchase or through the exercise of powers of eminent domain, if necessary. Following this action, all commercial, industrial, and residential property in areas subject to erosion are either demolished or relocated to another site. High rise condominiums, hotels and casinos with their ancillary parking lots and support industries would require relocation, thus destroying a cultural landmark of the New Jersey shore. Additionally, roads, railroads, water supply facilities, electric power, and telephone and sewerage utilities would also have to be relocated. Lands acquired in this manner could be used for undeveloped parks, or other purposes that would not result in material damage from erosion. The level of development at the problem area under study would make this measure prohibitively expensive.

3.2 NO ACTION ALTERNATIVE

The no action alternative would allow beach erosion to continue, resulting in an increased risk of property destruction during storms. The base condition of this alternative entails continuation of the existing serious beach erosion problem and storm damage threat, with reliance on emergency evacuation measures, floodplain regulations as required under Federal, State and local authorities and flood insurance under Federal programs. Continued erosion would reduce recreational opportunities. This would have the secondary economic effect of reducing tourism, which would in turn lower employment levels and the flow of revenue into the area. In the absence of Federal participation, limited State or local efforts to contain erosion and storm damage might be undertaken. However, small scale efforts would not be effective in meeting with the project's needs and goals. Therefore, this alternative was eliminated from further consideration.

3.3 COMPARATIVE IMPACT ANALYSIS OF THE ALTERNATIVES

The beach nourishment alternative best meets the needs and objectives for the ocean front portion of the project, and was chosen as the basis for further environmental, engineering, design and cost estimate evaluations. The construction of two

timber sheet-pile bulkheads best meets the needs and objectives for the Absecon Inlet frontage. The screening criteria used to evaluate some of the various alternatives and the results of that screening are shown on Tables 5 through 8. **A detailed discussion** of alternative screening can be found in the Plan Formulation section of the main report.

3.4 PREFERRED ALTERNATIVE: BEACH NOURISHMENT

Because the previously discussed alternatives would not fully accomplish the study objectives, the beach nourishment alternative is the preferred plan for the ocean front. The beach nourishment plan recommends that a selected berm width along with a selected dune height be maintained along the Absecon Island ocean frontage. Periodic re-nourishment will be necessary to maintain desired berm widths and dune heights. **The preferred** alternative also includes the construction of two timber sheet-pile bulkheads along the Absecon Inlet frontage.

3.5 THE SELECTED NED PLAN

Several intermediate alternatives utilizing various beach nourishment schemes were screened during Cycle 3 of the Feasibility Study. The plan selected from this screening is the NED (National Economic Development) Plan. The NED plan is the alternative with the highest net benefits for storm damage reduction over costs. The selected (NED) plan, berm and dune restoration through beach nourishment, consists of a 200 foot wide berm with a top elevation of +8.5 feet NGVD. A dune with a top elevation of +16 feet NGVD29, top width of 25 feet, and side slopes of 1V:5H will also be constructed, with the landward toe of the dune located 25 feet seaward of the seaward edge of the boardwalk. In Ventnor, Margate, and Longport the beachfill will have a 100 foot wide berm with a top elevation of +8.5 feet NGVD. Dunes will also be constructed to a top elevation of +14 feet NGVD, with a 25 foot top width, and side slopes of 1V:5H. The selected plan will be transitioned from a 200 foot berm to a 100 foot berm between Atlantic City and Ventnor for a distance of 1000 feet. The selected plan also includes the construction of two timber sheet-pile bulkheads along Absecon Inlet. Details of

Table 5
Absecon Inlet (Atlantic City)
Cycle 1 - First Level Screening Results

Alternative	Technical Feasibility	Meet Objectives?	Relative Cost	Further Consideration in Cycle 2?	Remarks
Nonstructural Alternatives	Partial	No	Varies	No	Could encourage development in coastal wetlands.
Beach Restoration	Partial	Partial	Moderate	Yes	Adverse environmental impacts can be minimized through coordination with environmental agencies. Existing shoreline slope may not be adequate to support stable berm. May increase inlet shoaling.
Bulkhead with revetment	Yes	Partial	Moderate	Yes	Bulkheads would require toe protection.
Navigation Type Breakwater	Partial	Partial	Very High	No	Reduces wave heights in navigation channel and on inlet shoreline. Costs must be offset by benefits to navigation and reduced periodic nourishment requirements.
Realignment of the Channel	No	No	High	No	Depth is already greater than the authorized channel throughout the inlet. Modifications may have adverse impact on channel stability.
Relocate Boardwalk	Yes	Partial	High	Yes	
Perched Beach (Geo-tubes)	Partial	Partial	High	No	Existing water depth is too deep to accommodate a perched beach with sufficient berm width to provide shore protection benefits.
Wave Breaking Structure	Yes	Partial	Moderate	Yes	Rough slope to absorb wave energy before impacting on bulkhead.
Lengthen Brigantine Jetty	Partial	Partial	Very High	Yes	May have adverse impacts on natural bypassing of sediment to Absecon Island.

Table 6
Absecon Island Ocean Front
Cycle 1 - First Level Screening Results

Alternative	**Technical Feasibility**	**Meet Objectives?**	**Relative Cost**	**Further Consideration in Cycle 2?**	**Remarks**
Nonstructural Alternatives	Partial	No	Varies	No	Could encourage development in coastal wetlands.
Beach Restoration	Yes	Partial	Moderate	Yes	Berm pushes the breaker zone and inundation profile seaward. Provides sacrificial sediment during storms.
Beach Restoration with Dune	Yes	Yes	Moderate	Yes	Provides buffer during storms and can provide aesthetic value by planting with dune grass. Dune grass can also help to stabilize the dune for storm protection.
Beach Restoration with Bulkheading	Yes	Yes	High	Yes	Bulkheads perform the same function as dune but is more costly and may require toe protection and can cause adverse affects during storms.
Beach Restoration with Groin field	Yes	Yes	High	Yes	Costs must be offset by reduced periodic nourishment requirements.
Offshore Berm	Partial	Partial	Moderate	No	Costs must be less than direct placement of material on beach.
Offshore Detached Breakwaters W/ Beachfill	Partial	Partial	Very High	No	Costs must be offset by reduced periodic nourishment requirements. Less viable in high wave energy environments.
Seawall	Yes	Partial	Very High	No	There is debate that seawalls can exacerbate erosion.
Perched Beach	Partial	Partial	High	No	Costs must be offset by reduced periodic nourishment requirements.
Submerged Reef W/ Beachfill	Partial	Yes	High	No	Costs must be offset by reduced periodic nourishment requirements.
Extend Longport Terminal Groin w/beachfill	Yes	Yes	High	Yes	Costs must be offset by reduced periodic nourishment requirements.

Table 7
Absecon Inlet (Atlantic City)
Cycle 2 - Second Level Screening Results

Alternative	Design Considerations	Environmental Considerations	Social Considerations	Preliminary Annualized Costs	Total Annualized Damages	Further Consideration in Cycle 3?	Remarks
Beach Restoration	50' Berm	Smother organisms on beach. Kill organisms in borrow area.	Provide usable beach area.	$900,000	$1,425,000	No	The existing slope would require a substantial quantity of material for stability. This project would have to be built in conjunction with the extension of the Brigantine Jetty.
Relocate Boardwalk	1,700 linear feet.		Increased accessibility.	$106,000	$96,000 (Boardwalk damages only.)	No	Costs outweigh potential benefits.
Wave Breaking Structure	1,050 linear feet.	Reduce sandy environment. Increase rocky habitat.	Less aesthetically pleasing than sandy beach.	$96,000	$1,425,000	Yes	
Bulkheading with revetment	1,050 linear feet.	Reduce sandy environment.	Uniformity of inlet bulkheading would provide better appearance than currently exists.	$89,000	$1,425,000	Yes	Bulkheads would require toe protection (rubble revetment) and can cause increased runup during storms.
Lengthen Brigantine Jetty	Extend 2000 feet to a total length of 5,749 ft at +8ft MLW.	Temporary dredging impacts such as increased turbidity and destruction of benthic habitat.	Reduced wave energy in inlet providing safe haven for boaters. Hazard to navigation.	$521,000	$1,425,000	Yes	Costs must be offset by reduced wave damages only.

Table 8
Absecon Island Ocean Front
Cycle 2 - Second Level Screening Results

Alternative	Design Considerations	Environmental Considerations	Social Considerations	Preliminary Annualized Costs	Total Annualized Damages	Further Consideration in Cycle 3?	Remarks
Beach Restoration	100' Berm, +8.5 ft. NGVD.	Smother organisms. Kill organisms in borrow area. Can increase nesting and beach habitat.	Provide usable beach area.	$1,329,000	$16,025,000	Yes	Adverse environmental impacts can be minimized through coordination with environmental agencies.
Beach Restoration with Dune and Groin field	AC: Two stone groins, 1200' apart, 400' length from 10'MLW to 7' MLW at seaward end.	Same as beach restoration.	Same as beach restoration but there may be aesthetic problems with hardened structures.	$607,000 (Atlantic City only)	$6,943,000 (Atlantic City only)	Yes	Costs must be offset by reduced periodic nourishment requirements.
	Longport: Six stone groins, 100' apart, 400' length from 10'MLW to 7' MLW at seaward end.			$1,375,000 (Longport only)	$4,943,000 (Longport only)	Yes	
Beach Restoration with Bulkheading (no dune)	100' Berm, 12,700 l.f. bulkhead (Atlantic City).	Same as beach restoration.	Same as beach restoration.	$1,071,000 (Atlantic City)	$6,943,000 (Atlantic City)	No	Bulkheads perform the same function as dune but are more costly. Road ends are existing low points in elevation.
	100' berm, 1400 l.f. bulkhead at road ends (Margate, Ventnor & Longport).			$1,198,000 (Ventnor, Margate & Longport).	$9,082,000 (Ventnor, Margate & Longport).	Yes	
Beach Restoration with Dune	185' berm and dune width. Berm: +8.5 ft. NGVD. Dune: 25 ft top width, +12.5 ft. NGVD.	Same as beach restoration, in addition, enhancement of backshore environment.	Same as beach restoration but there are those who are inconvenienced by dunes.	2,118,000	$16,025,000	Yes	Provides buffer and sediment stockpile during storms and can provide aesthetic value by planting with dune grass.
Extend Longport Terminal Groin	1000' total length.	Temporary dredging impacts such as increased turbidity and destruction of benthic habitat.		$128,000	$4,943,000 (Longport only)	Yes	Costs must be offset by reduced periodic nourishment requirements. Possible effects on the Great Egg Harbor Inlet ebb shoal.

the selected plan are shown on Figures 2 and 3. The selected plan includes:

A total sand fill quantity of approximately 6.2 million cubic yards is needed for the initial fill placement over the entire length. This quantity includes tolerance, overfill and advanced nourishment.

91 acres of planted dune grass and the erection of 63,675 linear feet of sand fence for entrapment of sand on the dune and delineating walkovers and vehicle access ramps.

170 pedestrian dune walkovers and 10 vehicle access ramps over the dunes.

Renourishment of approximately 1,666,000 cubic yards of sand fill from the offshore borrow area every 3 years for the 50 year project life.

Beachfill for the proposed project is available from 3 offshore borrow areas with a total area of approximately 753 acres. The proposed borrow areas are located within Absecon Inlet, offshore of Absecon Inlet, and offshore of Great Egg Harbor Inlet. Details of the borrow sites and the borrow material are provided in the Borrow Area Selection section of the Main Report.

To properly assess the functioning of the proposed plan, monitoring of the placed beachfill, borrow area, shoreline, wave and littoral environment is included with the plan. Environmental monitoring is being addressed through coordination with other interested agencies, and will be finalized prior to initial construction.

3.5.1 OFFSHORE BORROW AREA INVESTIGATION

Through the use of maps and charts which show offshore bathymetry, plans and specifications records for previous beachfill jobs, literature which included vibracore logs from previous investigations, and coordinates for overboard disposal areas of dredged material, the three proposed borrow areas in this report were identified. Based upon the search of existing literature, the three areas identified as potential borrow sites include all of the likely sites where large deposits of sand can be found. The Absecon Inlet borrow area was initially identified since portions of this area had been mined previously for beachfill. The Great Egg Harbor Inlet borrow area was initially identified due to the fact that a portion of the ebb shoal was already in use supplying high-quality beachfill material for Ocean City, N.J. The offshore borrow area was initially identified as a bathymetric feature (a shoal) which would probably contain suitable beachfill material. The vibracores were then conducted for these areas to obtain sediment samples for testing and suitability analysis. The vibracore samples verified the suitability of sand within these three borrow areas for use as beachfill material for Absecon Island. All three borrow areas were then designated as possible borrow sites for the Absecon Island project. Once these areas were identified as sources of suitable beachfill material, environmental and cultural investigations were completed. The environmental field investigations consisted of benthic sampling and tows for surf clams. The results of these investigations indicated that the use of Absecon Inlet borrow area would reduce the impacts to benthic and surf clam resources, as the offshore area and Great Egg Harbor Inlet area have much higher densities of surf clams. To further lessen any impacts to surf clams, the size of the Absecon Inlet borrow area was curtailed and it was decided that the initial quantity of sand and the first few nourishment cycles would utilize this borrow site.

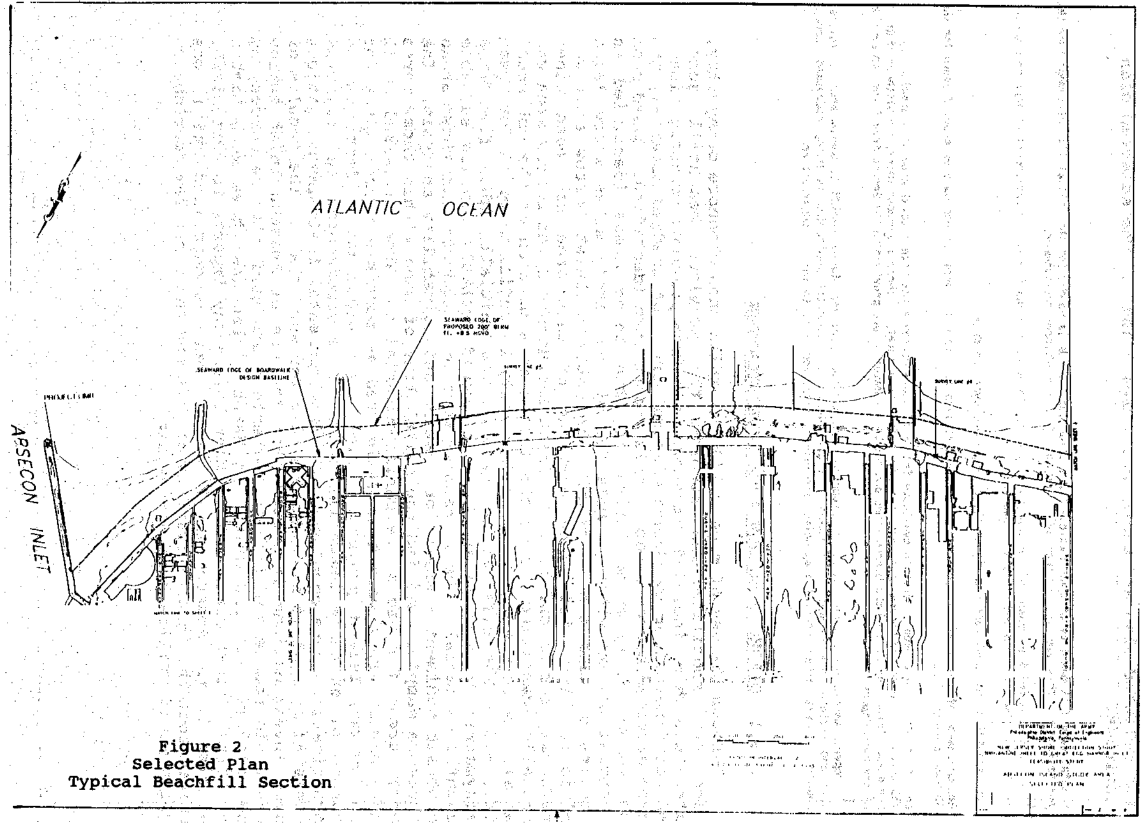


Figure 2
Selected Plan
Typical Beachfill Section

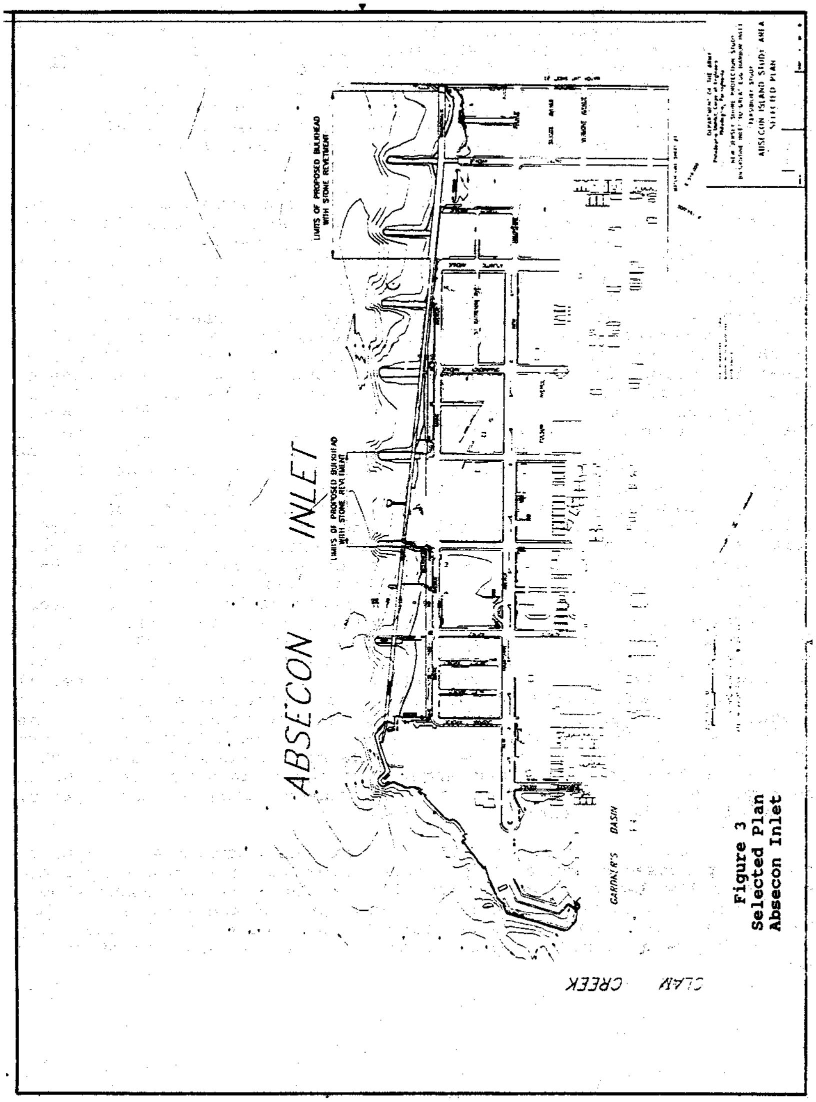


Figure 3
Selected Plan
Absecon Inlet

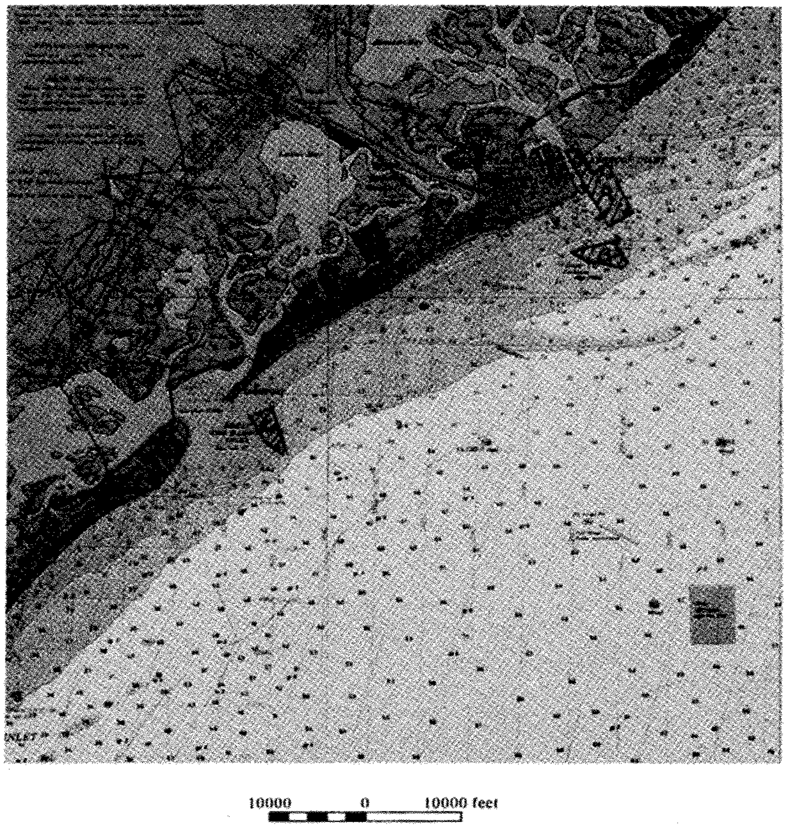
The Reconnaissance Study report identified several possible borrow areas for Absecon Island. In order to specifically identify sources of sand for the Absecon Island feasibility study, a series of 15 vibrocores were collected. The vibrocores were collected by Alpine Ocean Seismic Survey, Inc. in the Atlantic Ocean off of the coast of New Jersey. The samples were collected between 12 October and 27 October 1993. The desired depth of penetration for the vibrocores was 20 feet. Sieve analysis of the sediment retrieved in the vibrocores was conducted by the Army Corps of Engineers South Atlantic Division Laboratory (SAD Lab).

Vibrocore borings for borrow area identification were accomplished in three specific locations. The first location was Absecon Inlet, the second location was offshore of Atlantic City, and the third location was Great Egg Harbor Inlet (Figure 4). The results of the vibrocore investigation and analysis indicate that all three of these areas meet the criteria for potential borrow areas for Absecon Island. The first potential borrow area is the northern portion of Absecon Inlet. The second potential borrow area lies approximately 1 to 1-1/4 miles offshore of Atlantic City. The third area is located northeast of Great Egg Harbor Inlet. All three areas contains large quantities of fine sand as identified by the sieve analysis conducted by the SAD Lab. Ideally, borrow material should be the same size, or slightly coarser than the native material on the beach to be nourished. If the borrow material has a significantly smaller grain size, the profile will be out of equilibrium with the local wave and current environment, and will therefore be quickly eroded either offshore or alongshore. This analysis compares the native sediment characteristics to the borrow material characteristics. Overfill factors and renourishment factors were calculated for each potential borrow area. The overfill factor estimates the volume of fill material needed to produce one cubic yard of stable beach material after equilibrium (when the beach and native materials are compatible) is reached. Consequently, overfill factors are greater or equal to one. For example, an overfill ratio of 1.2 would indicate that 1.2 cubic yards of borrow material would be required to produce 1.0 cubic yards of stable beach material. This technique assumes that both the native and composite borrow material distributions are nearly log-normal. The renourishment factor is a measure of the stability of the placed borrow material relative to the native beach sand. Desirable values of the renourishment factor are those less than or equal to one. For example, a renourishment factor of 0.33 would mean that renourishment using the borrow material would be required one third as often as renourishment using the same type of material that is currently on the beach.

Based on the information gathered from the vibrocores, it appears that the proposed borrow area in Absecon Inlet would provide compatible sand with the least amount of overfill and the longest renourishment cycle. The Absecon Inlet offshore borrow area and the Great Egg Harbor Inlet borrow area would require larger amounts of overfill, and would have more frequent renourishment cycles than the Absecon Inlet borrow area.

Figure 4

Absecon Island Borrow Areas



Absecon Island Borrow Areas

3.6 SUMMARY OF ENVIRONMENTAL EFFECTS OF PLAN

The primary adverse impact of the beach nourishment alternative is the temporary disturbance and destruction of existing benthic resources from dredging operations at the borrow area, and fill placement along the shorefront. Dredging in the borrow area will result in a temporary destruction of the benthic commmunity, however, rapid recolonization is expected to occur within one year from dredging. Minor shifts in benthic community composition may occur following recolonization. Beachfill operations along Absecon Island will result in temporary degradation of the existing beach habitat during initial construction and periodic nourishments. Existing benthic organisms on the beach would become buried as a result of beachfilling operations. Due to the presence of species adapted to high energy and dynamic conditions, recolonization of the beach area is expected to be rapid. The portion of benthic habitat covered by any seaward extension of the beach would represent a long-term loss, however, this would be offset by the creation of similar habitat. The partial burial of groins in the project area would represent a long-term loss of rocky intertidal habitat occupied by aquatic invertebrates that attract birds and fish. Fish and avian utilization of the immediate shoreline area for feeding would be temporarily disrupted, however, they are expected to return immediately after the disturbance. Dredging and the hydraulic placement of beachfill material will result in temporary higher turbidity levels at the borrow site and waters along the shoreline during construction.

The construction of the timber sheet-pile bulkheads and placement of a quarrystone revetment will also result in temporary higher turbidity levels and the disturbance of the benthic community within the inlet. This aspect of the proposed plan will result in the loss of sandy bottom habitat and the destruction of the benthic community within the area to be covered by the bulkheads and associated revetment. Once construction is completed, it is expected that the newly created rocky inter-tidal habitat will be colonized with a variety of marine organisms.

4.0 AFFECTED ENVIRONMENT

4.1 THE PROJECT SITE

Brigantine and Absecon Islands are separated from the mainland by 3 to 5 miles of shallow bays which include small uninhabited islands, tidal marshes, creeks and lagoons. The ground elevation of the islands is generally no more than 10 feet above mean sea level. Absecon Island is bounded by Absecon Inlet to the north and Great Egg Harbor Inlet to the south (Figure 5). The island contains the four communities of Atlantic City, Ventnor, Margate, and Longport. It is the most densely developed of the barrier beach islands along the New Jersey coast. Both Brigantine and Absecon Islands front the Atlantic Ocean on their eastern boundaries, and have extensive coastal and estuarine wetlands on their western boundaries.

Absecon Inlet lies between Brigantine Island and Absecon Island, and provides a navigable connection between the Atlantic Ocean and the harbor of Atlantic City and the New Jersey Intracoastal Waterway (Figure 5). The inlet is extensively used by recreational and deep draft commercial craft based behind Atlantic City.

Absecon Island, a barrier island which has been heavily developed as a residential and recreational area, is characterized by estuarine intertidal emergent wetlands behind a marine intertidal beach/bar. A large segment of the lands to the northwest of the barrier island are classified as a backbay/coastal salt marsh system. Brigantine Island is much less developed, and is primarily classified as a marine intertidal beach/bar behind which are palustrine emergent, estuarine intertidal and palustrine scrub-shrub wetlands. Common species of the beach and dune area on the barrier island system include beach grass, sea-rocket, seaside goldenrod, poison ivy, groundsel-tree, and marsh elder.

The backbays are comprised of open water, a low marsh zone, tidal flats, a high marsh zone, and a transition zone. The low marsh zone is typically dominated by saltmarsh cordgrass. Tidal flats are areas that are covered with water at high tide and exposed at low tide. They are important areas for algal growth, as producers of fish and wildlife organisms, and as nursery areas for many species of fish, mollusks and other organisms. Dominant species include sea lettuce and eelgrass. The high marsh zone, which is slightly lower in elevation than the transition zone is dominated by saltmeadow cordgrass and salt grass. This zone is typically flooded by spring high-tide. Plants typical of the transition zone include both upland and marsh species including marsh elder, groundsel-tree, bayberry, saltgrass, sea-blite, glasswort, poison ivy, and common reed.

4.2 CLIMATE

4.2.1 Temperature and Precipitation

The Delaware Bay and Atlantic Ocean coastal region experiences a moderate climate associated with the low elevations of the Coastal Plain and the presence of the large water bodies. A moderate winter season results from winds which are heated by warmer water temperatures of the ocean and bays and blown inland. Summer temperatures are in turn moderated by locally generated

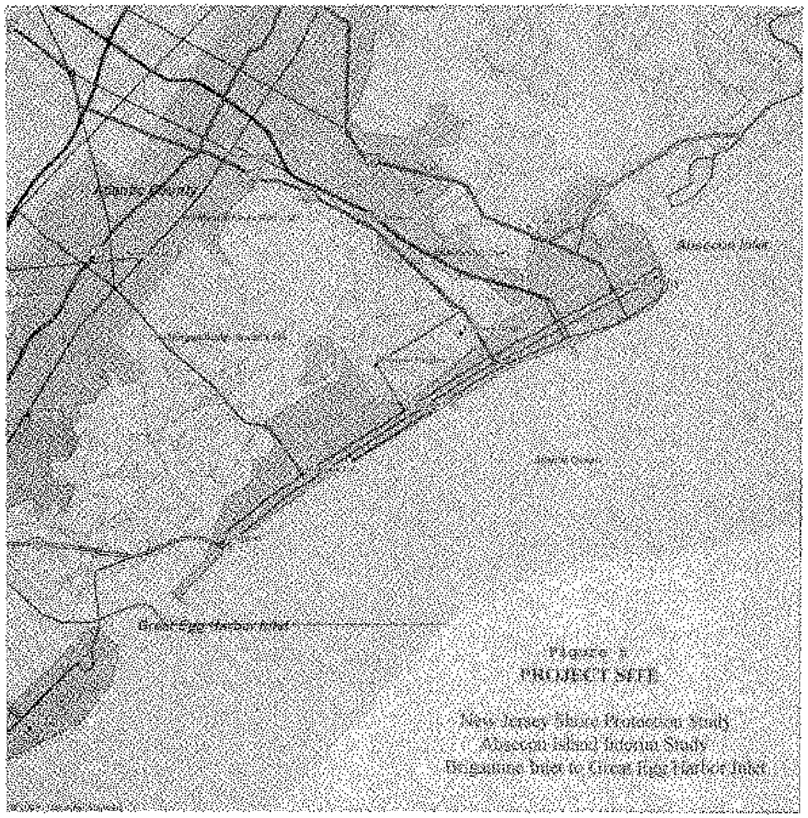


Figure 1
PROJECT SITE

New Jersey Shore Protection Study
Absecon Island Interim Study
Brigantine Inlet to Great Egg Harbor Inlet

winds or sea breezes. The following information is quoted from the 1992 Annual Summary of Local Climatological Data, and is considered to be fully representative of conditions along Absecon Island.

"Land and sea breezes, local circulations resulting from the differential heating and cooling of the land and sea, often prevail. These winds occur when moderate or intense storms are not present in the area, thus enabling the local circulation to overcome the general wind pattern. During the warm season sea breezes in the late morning and early afternoon hours prevent excessive heating. On occasions, sea breezes have lowered the temperature as much as 15 to 20 degrees within a half hour. However, the major effect of the sea breeze at the airport is preventing the temperature from rising above the 80's. Because the change in ocean temperature lags behind the air temperature from season to season, the weather tends to remain comparatively mild late into the fall, but on the other hand, warming is retarded in the spring. Normal ocean temperatures range from an average near 37 degrees Fahrenheit in January to near 72 degrees in August."

"Precipitation is moderate and well distributed throughout the year, with June the driest month and August the wettest. Tropical storms or hurricanes occasionally bring excessive rainfall to the area. The bulk of winter precipitation results from storms which move northeastward along, or in close proximity to, the east coast of the United States. Snowfall is considerably less than elsewhere at the same latitude and does not remain long on the ground. Precipitation, often beginning as snow, will frequently become mixed with or change to rain while continuing as snow over more interior sections. In addition, ice storms and resultant glaze are relatively infrequent."

4.2.2 Wind

As referenced in the 1984 Annual Summary from the State Marina site, the prevailing winds are from the south and of moderate velocity (14 to 28 miles per hour), and winds from the northeast have the greatest annual velocity (between 19 and 20 miles per hour). The wind data from this period also show that winds in excess of 28 miles per hour occur from the northeast more than twice as frequently as from any other direction.

The maximum five-minute average velocity at Atlantic City was recorded during the hurricane of September 1944, with a value of 82 miles per hour from the north. This storm also caused the largest recorded storm surge along the Atlantic coast of New Jersey. The fastest mile windspeed recorded at the Atlantic City Marina site over the 1960 to 1984 period was recorded during Hurricane Doria in August 1971. The fastest mile wind speed was 63 miles per hour from the southeast. The wind records generally reflect the fact that the most extreme, but infrequent, winds accompany hurricanes during the August to October period. Less extreme but more frequent high winds occur during the November to March period accompanying northeasters.

4.2.3 Storms

Storms of two basic types present a significant threat to New Jersey's coastal zone. Hurricanes are the most severe storms affecting the Atlantic Coast. Extratropical storms from easterly quadrants, particularly the northeast, also cause extensive damage to beaches and structures along the coast.

Tropical storms and hurricanes, spawned over the warm low latitude waters of the Atlantic Ocean, are probably the best known and most feared storms. Hurricanes, characterized by winds of seventy-five miles per hour or greater and heavy rain, plague the Gulf and Atlantic seaboards in the late summer and autumn. Historically, the Hurricane of 1944 and Hurricane Gloria are ranked first and fifth, respectively, in terms of maximum stage at the Atlantic City gage.

Extratropical storms, often called "northeasters", present a particular problem to the Atlantic seaboard. Such storms may develop as strong, low pressure areas over land and move slowly offshore. The winds, though not of hurricane force, blow onshore from a northeasterly direction for sustained periods of time and over very long fetches. The damage by these storms may ultimately exceed the destruction from a hurricane. The March 1962 Northeaster ranks second only to the 1944 hurricane in terms of maximum stage. The northeasters which occurred in November 1950 and December 1992 rank third and fourth for the Atlantic City gage.

The intensity and thus the damage-producing potential of coastal storms are related to certain meteorological factors such as winds, storm track, and amount and duration of precipitation. However, the major causes of coastal damage tend to be related to storm surge, storm duration, and wave action. Storm surge and wave setup are discussed in the storm erosion and inundation analysis in the without project conditions section of the Main Report.

4.3 GEOLOGY, SOILS, AND TOPOGRAPHY

4.3.1 Geology

The Atlantic coastal plain consists of sedimentary formations overlying a crystalline rock mass known as the "basement". From well drilling logs it is known that the basement slopes at about 75 feet per mile from the Fall Line to a depth of more than 6,000 feet near the coast. Geophysical investigations have corroborated these findings and have permitted determination of the profile seaward to the continental slope. A short distance offshore, the basement surface drops abruptly but rises again gradually as the continental slope is approached. Overlying the basement are semi-consolidated beds of lower Cretaceous sediments. These beds vary greatly in thickness, increasing seaward to a maximum thickness of 13,300 feet then decreasing to 8,900 feet near the edge of the continental shelf. On top of the semi-consolidated material lie unconsolidated sediments of Upper Cretaceous and Tertiary formations. These materials, in relatively thin beds on the land portion of the coastal plain, increase in thickness to a maximum of 4,800 feet near the edge of the continental shelf.

4.3.2 Soils and Topography

About 85 percent of the shorefront of New Jersey consists of a chain of narrow barrier beaches with elevations generally less than 20 feet above sea level. These beaches, each of which is approximately 7 miles in length, are separated by ten inlets. The remaining shorefront from Long Branch to Bay Head and that at Cape May Point Point, is mainland of much earlier origin than the barrier islands.

The entire portion of the coastal plain draining to the study area is a sedimentary feature that developed under essentially the same set of conditions for a considerable period of geologic time. The area is capped with almost entirely unconsolidated sediments of Tertiary or more recent deposition. During Quaternary time, changes in sea level caused the streams alternately to spread deposits of sand and gravel along drainage outlets and later to remove, rework, and redeposit the material over considerable areas, concealing earlier marine formations. One of these, the Cape May formation, consisting largely of sand and gravel, was deposited during the last interglacial stage when sea level stood 30 to 40 feet higher than at present. The material was deposited along valley bottoms, grading into the estuarine and marine deposits of the former shoreline. These deposits now stand as terraces along portions of the coast and form the mainland bluff at Cape May. The barrier beaches being of relatively recent origin are composed of the same material as the offshore bottom.

4.4 COASTAL HYDRAULICS

4.4.1 Tides

The tides affecting the study area are classified as semi-diurnal with two nearly equal high tides and two nearly equal low tides per day. The average tidal period is actully 12 hours and

25 minutes, such that two full tidal periods require 24 hours and 50 minutes. Thus, tide height extremes (highs and lows) appear to occur almost one hour (average is 50 minutes) later each day. The mean tide range for the Atlantic Ocean shoreline is reported as 4.1 feet in the Tide Tables published annually by the National Oceanic and Atmospheric Administration (NOAA). The spring tide range is reported as 5.0 feet. Absecon Channel and the back bay areas adjacent to the study area show only a small attenuation of the tide range relative to the ocean shoreline.

The NOS (National Ocean Service) tide gage nearest to the study area shoreline is located at the Trump Taj Mahal oceanfront pier in Atlantic City. Historically, a gage has been located on Absecon Island since July 1911. In July 1985, the gage was moved from its location at the Atlantic City Steel Pier, two miles south to a municipal fishing pier in Ventnor. In January 1992, the gage was moved from Ventnor to its present location at the Trump Taj Mahal Pier.

As part of the data collection efforts by the Philadelphia District, tidal data is being collected at a gage located inside of Absecon Inlet, adjacent to the highway bridge carrying Brigantine Boulevard over the Inlet. This gage collected data from November 1993 through October 1994, corresponding to the deployment period of the offshore wave gage. A summary of the tidal data collected is provided in the without project conditions section of the Main report.

4.4.2 Waves

The most recent analysis of general wave statistics for the study area shoreline is presented in a report entitled "Hindcast Wave Information for the U. S. Atlantic Coast" (Wave Information Study (WIS) Report 30) prepared by Hubertz, et al., 1993. The revised WIS data is also available digitally through the Coastal Engineering Data Retrieval System (CEDRS) developed by the U.S. Army Engineer Coastal Engineering Research Center. WIS Report 30 and information in CEDRS provides revised wave data for 108 locations along the U. S. Atlantic coast, and supersedes WIS Report 2 (Corson, et al. 1981), WIS Report 6 (Corson, et al. 1982) and WIS Report 9 (Jensen 1983). The wave information for each location is derived from wind fields developed in a previous hindcast covering the period 1956 through 1975 and the present version of the WIS wave model, WISWAVE 2.0 (Hubertz 1992). Wave heights are universally higher for the revised hindcast than for the original hindcast, since the values more closely correspond to maximum measured (buoy) values.

Hindcast results are available as time series every 3-hr for the 20-yr period or as tabular summaries. WIS Report 30 contains tables presenting the distribution of spectral wave height, peak period and peak mean direction by month for the 20-yr period; the number of occurrences by 1-m height and 2-sec period categories for eight different direction bands and a final table for all directions; the distribution of wind in 2.5-m/sec and 45-deg speed and direction categories on a monthly basis; and finally summary tables of mean and maximum wave heights by month for each of the 20 years hindcast. These tables also include the peak period and peak mean wave direction associated with the maximum wave height occurrence.

The WIS output results are a verified source of information for wind and wave climate along the U.S. Atlantic Coast, and have been used to gain a basic understanding of the wind and wave climate at Absecon Island. The wave statistics pertinent to the Absecon Island study are those derived for Station 68 of WIS Report 30. The location of Station 68 is Latitude 39.25 N, Longitude 74.25 W, in a water depth of approximately 60 ft. Monthly mean wave heights at Station 68 for the entire 20-yr hindcast range from 2.4 ft in August to 4.4 ft in December. The maximum wave height (H_{mo}) at Station 68 for the 20-yr period is reported as 22.6 ft, with an associated peak period of 14 sec and a peak direction of 86 deg on 7 March 1962. The maximum wind speed for Station 68 for the 20-yr hindcast is reported as 89 ft/sec at 20 deg on 7 March 1962.

The actual wave spectrum experienced at any particular time along the project shoreline may show considerable local variation. This variability is largely due to the interaction of incident waves with: tidal currents at Absecon and Great Egg Inlets, ebb shoal morphology at the two inlets, local shoreline alignment, nearshore bathymetry, and presence of shoreline stabilization structures. Therefore, the hindcast wave statistics should be viewed as a very general representation of the wave climate of the study area offshore. Inshore of the 60 ft depth, the effects enumerated above will modify the incident waves such that significant alongshore differences may exist with respect to breaking wave height and angle relative to the shoreline. Computer programs which transform offshore waves over varying bathymetry must be used to further investigate wave conditions closer to the shoreline.

Prototype wave data collection in the vicinity of Absecon Island was collected for the Philadelphia District between November 1993 October 1994. A directional wave gage of the "PUV" type collected data at a depth of approximately 35 ft offshore of the Trump Taj Mahal Pier. A nearshore directional wave gage collected data in approximately 10 ft of water near the entrance to Absecon Inlet. Wave data were analyzed and utilized in the with-project shoreline and inlet process modeling efforts. Prototype wave data summaries are presented in the Main Report.

4.4.3 Currents

The Philadelphia District collected tidal current data offshore just south of the Absecon Inlet mouth from November 1993 to January 1995. This data includes a large set of current speed and direction measurements at a single location from a bottom mounted self-recording current meter. This data is more relevant to ocean facing shoreline parallel tidal currents than inlet currents because of the location of the current meters. The data was taken at three hour intervals. Typical plots of tidal current data are provided in Appendix A of the main report.

In addition, tidal currents and flow estimates for Absecon and Brigantine Inlets are available from a study conducted in September 1994 by CERC for the Philadelphia District. Acoustic Doppler Current Profiler (ADCP) measurements were taken at Absecon Inlet to provide estimates of depth averaged currents at specified crossections and flow volumes as a function of time over most of a tidal cycle. Typical plots of the current data collected are provided in Appendix A of the main report.

The data collected across the inlet throat indicate that during flood tide the higher water velocities are located on the south side of the channel. During ebb tide, the currents are generally uniform across the channel. During peak ebb, slightly higher velocities are concentrated on the north side of the inlet. At maximum flood, depth-averaged water velocities of over 5.6 ft/sec were measured. In general, ebb velocities were lower than the flood velocities. Typically, maximum water velocities on the ebb tide were on the order of 4.9 ft/sec.

Maximum tidal current velocities through Absecon Inlet have been previously documented as 3.1 ft/sec (U.S. Army Corps of Engineers, 1943) with currents flowing past the adjacent beaches reaching maximum velocities of less than 1.0 ft/sec.

4.5 WATER QUALITY OF NEW JERSEY ATLANTIC COASTAL WATERS

4.5.1 Temperature and Salinity

Mixing occurs in nearshore waters due to the turbulence created from wave energy contacting shallower depths. This mixing becomes less prominent in greater depths where stratification can develop during warm periods. Water temperatures generally fluctuate between seasonal changes. The average temperature range is from 3.7°C (January) to 21.4°C (October). The most pronounced temperature differences are found in the winter and summer months. Warming of coastal waters first becomes apparent near the coast in early spring, and by the end of April thermal stratification may develop. Under conditions of high solar radiation and light winds, the water column becomes more strongly stratified during the months of July to September. The mixed layer may extend to a depth of only 12 to 13 feet. As warming continues, however, the thermocline may be depressed so that the upper layer of warm, mixed water extends to a depth of approximately 40 feet. Salinity concentration is chiefly affected by freshwater dilution. Salinity cycles result from the cyclic flow of streams and intrusions of continental slope water from far offshore onto the shelf. Continental shelf waters are the least affected by freshwater dilution, and have salinity concentrations varying between 30 parts per thousand (ppt) and 35 ppt. Coastal waters are more impacted by freshwater dilution, and may have salinities as low as 27 ppt. Salinity is generally at its maximum at the end of winter. The voluminous discharge of fresh water from the land in spring reduces salinity to its minimum by early summer. Surface salinity increases in autumn when intrusions from offshore more than counterbalance the inflow of river water, and when horizontal mixing becomes more active as horizontal stability is reduced. Recent near-bottom water quality parameters were measured, in October 1994, within the proposed sand borrow sites during benthic sampling. The near-bottom temperature ranged from 15.1 - 15.9°C, and the dissolved oxygen and salinities ranged from 6.0 - 7.7 mg/L and 31.4 - 31.7 ppt, respectively (Battelle Ocean Sciences, 1995).

4.5.2 Water Quality Parameters

Through the State of New Jersey's Cooperative Coastal Monitoring Program (CCMP), coastal and backbay water quality is monitored by the Atlantic County Health Department and Atlantic City Health Department. Ocean and bay stations are monitored once a week from May to September for fecal coliform. According to the New Jersey Department of Environmental Protection (NJDEP) Surface Water Quality Standards (SWQS) NJAC 7:9 4.1, fecal coliform levels for ocean areas are not to exceed 50 per 100 milliliters of sample (SWQS 50). For the bay areas, fecal coliform concentrations are not to exceed 200 per 100 millimeters (SWQS 200). Eight sites in Atlantic County are also analyzed for enterococci bacteria in an effort to quantify other bacterial indicators of contamination. The following data is derived from the Coastal Cooperative Monitoring Program Annual Reports, published by the Division of Water Resources, NJDEP.

In 1989, 28 ocean and 15 bay stations were monitored as part of this program. Of the 570 ocean samples collected, 93 exceeded the SWQS 50 and 21 exceeded the primary contact criterion of 200 per 100 milliliters of sample (PCC 200). Thirty-six of the 272 bay samples exceeded the SWQS and PCC 200. Excessive, continuous rainfall contributed to bacterial loading from stormwater pipes into the surf zone. Of the 466 samples collected from 26 ocean stations in 1988, 44 of the samples exceeded the SWQS 50 and 4 exceeded the PCC 200. In addition, 218 bay stations were monitored and 27 samples exceeded SWQS and PCC 200. In 1987, 587 ocean samples were collected and 83 samples exceeded SWQS 50 and 36 exceeded PCC 200. The ocean stations with geometric means exceeding the SWQS were located in Atlantic City. Thirty-seven of the 183 bay samples collected from 10 bay stations exceeded SWQS and PCC 200.

As a result of this monitoring program, recreational beaches may be closed if two consecutive fecal coliform concentrations are above the PCC. From August 17 to 22, 1987, the entire Atlantic City beach was closed due to contaminated water flow from stormwater pipes discharging to the ocean. Several possible sources of contamination into the storm sewer system were identified. Beach closings in 1988 were abnormally high due to a malfunction at the Asbury Park wastewater treatment facility. This incident occurred immediately prior to its conversion from a primary level sewage treatment to secondary level.

According to the CCMP's 1993 Annual Report, bacteria-related closings of ocean beaches from 1988 through 1991 decreased but then increased again in 1992 and 1993. These closings were attributed to stormwater discharges, rather than discharges from wastewater treatment facilities. In 1991, isolated beach closures occurred after rains. Stormwater can be contaminated during overland flow during rainfalls, and during underground transport before being discharged into a waterway. In contrast to the 1991 numbers, 27 beach and 84 bay closings occurred in 1992. Twenty-two of the beach closings occurred immediately following five days of rain in August. Concentrations of fecal coliforms increase after rain due to the flushing effect of stormwater runoff. Excessive fecal coliform concentrations or suspected sewage pollution accounted for 26 of the 27 ocean beach closings and all of the bay beach closings in 1992. In comparison, 10 ocean beach closings in 1991 were attributable to those causes. In 1993, some of the 34 beach and 54 bay closings were attributed to sewage discharges related to occurrences of stormwater discharge.

No closings due to floatable debris washups have occurred since 1990. It is believed that the floatables removal activities of the U.S. Army Corps of Engineers, and the DEP's Operation Clean Shores are in part responsible for the decrease in floatables in the harbors and nearshore coastal waters. Table 9 compares the number of beach and bay closings from 1988 through 1993.

The results of the Coastal Cooperative Monitoring Program have indicated that direct stormwater discharge to the ocean, and indirect discharge via tidal flow from the bay inlets, can be correlated with increased concentrations of fecal coliform at the program stations. Compounding the stormwater effect on backbay fecal coliform levels are bacterial loadings from illegal discharge of marine sanitation devices on boats, the pressure of large animal populations, and the resuspension of sediments by boat traffic and dredging.

Another indication of the water quality in an area can be derived from the State of New Jersey's annual Shellfish Growing Water Classification Charts. Waters are classified as approved, special restricted, seasonal or prohibited for the harvesting of shellfish as seen in Figure 6. In general the poorest water quality areas are located in the nearshore environment of the heavily populated Atlantic City, and backbay harbors and thorofares where circulation and flow is restricted on either one or both ends. The near shore waters from Absecon Inlet to Ventnor City are prohibited (condemned) for the harvest of oysters, clams and mussels. The waters of Absecon Inlet are seasonal/special restricted. Seasonal areas are condemned for the harvest of shellfish except during certain times, while special restricted areas are condemned for the harvest of shellfish except for further processing under special permit. The backbays immediately adjacent to Brigantine Island are classified as seasonal; however, the waters that extend further back towards Reeds Bay are approved for shellfish harvesting. The waters within one mile of Brigantine's beaches are classified as a Surf Clam Conservation Zone. The backbays extending from Absecon Inlet to Great Egg Harbor Inlet are for the most part seasonal or special restricted. A few isolated thorofares and harbors are classified as prohibited.

4.6 TERRESTRIAL ECOLOGY OF AFFECTED AREA

4.6.1 Dunes

The study area encompasses both the barrier island and back bay/coastal salt marsh systems. Absecon Island, a barrier island which has been heavily developed as a residential and recreational area, is characterized by estuarine intertidal emergent wetlands behind a marine intertidal beach/bar. A large segment of the lands to the northwest of the barrier island are classified as a back bay/coastal salt marsh system.

Although typical beach dunes and the habitats associated with them are almost non-existent within the project area, a few elements of beach dune flora and fauna are still present. The only area currently having a dune system within the project area is in Atlantic City where small man-made dunes exist in some sections. The following discussion on beach dunes mainly pertains to surrounding areas outside of the Absecon Island project impact area, however, some of the dune flora and fauna discussed may still be present in limited pockets.

TABLE 9

Beach Closings

	Reasons	1993	1992	1991	1990	1989	1988
Ocean Closings	Bacteria	34	27	10	22	35	784
	Floatables	0	0	0	10	9	19
	Total	34	27	10	32	44	803
Bay Closings	Bacteria	54	84	97	202	232	52

Source: New Jersey Department of Environmental Protection, Cooperative Coastal Monitoring Program, The Annual Report for 1993

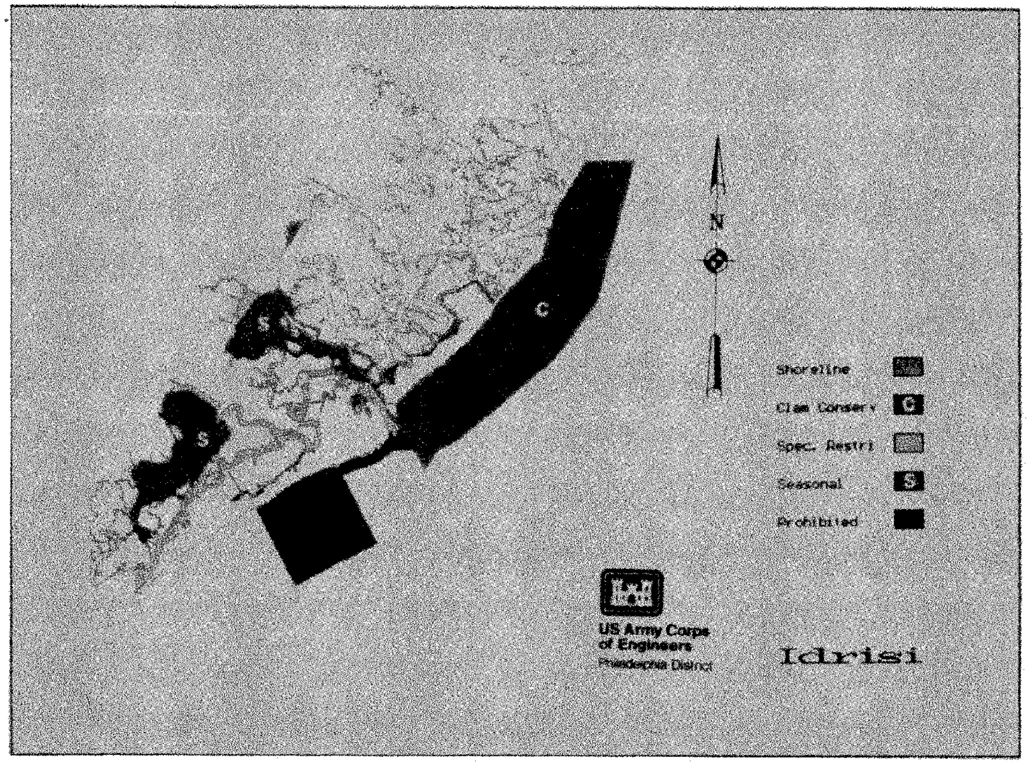


FIGURE 6   Shellfish Growing Water Classification Chart. Digitized from NJDEPE, 1992.

In typical undisturbed beach profiles along the Atlantic Coast of New Jersey, the primary dune is the first dune landward from the beach. The flora of the primary dune are adapted to the harsh conditions present such as low fertility, heat, and high energy from the ocean and wind. The dominant plant on these dunes is American beachgrass (Ammophila breviligulata), which is tolerant to salt spray, shifting sands and temperature extremes. American beachgrass is a rapid colonizer that can spread by horizontal rhizomes, and also has fibrous roots that can descend to depths of 3 feet to reach moisture. Beachgrass is instrumental in the development of dune stability, which opens up the dune to further colonization with more species like seaside goldenrod (Solidago sempervirens), sea-rocket (Cakile edentula) and beach cocklebur (Xanthium echinatum).

The secondary dunes lie landward of the primary dunes, and tend to be more stable resulting from the protection provided by the primary dunes. The increased stability also allows an increase in plant species diversity. Some of the plant species in this zone include: beach heather (Hudsonia tomentosa), coastal panic grass (Panicum amarum), saltmeadow hay (Spartina patens), broom sedge (Andropogon virginicus), beach plum (Prunus maritima), seabeach evening primrose (Oenothera humifusa), sand spur (Cenchrus tribuloides), seaside spurge (Ephorbia polygonifolia), joint-weed (Polygonella articulata), slender-leaved goldenrod (Solidago tenuifolia), and prickly pear (Opuntia humifusa).

Along undeveloped portions of the New Jersey Atlantic Coastline, the primary and secondary dunes grade into a zone of shrubby vegetation. These zones are typically located on the headlands or on the barrier flats of the barrier beaches. This zone is called the scrub-thicket zone where sand movement is more diminished. Many of the flora are dwarf trees and shrubs which include: wax-myrtle (Myrica cerifera), bayberry (M. pensylvanica), dwarf sumac (Rhus copallina), poison ivy (Toxicodendron radicans), black cherry (Prunus serotina), American holly (Ilex opaca), greenbrier (Smilax spp.), groundsel bush (Baccharis halimifolia), loblolly pine (Pinus taeda), pitch pine (Pinus rigida), Virginia creeper (Parthenocissus quinquefolia), beach plum (Prunus maritima), and the non-native Japanese black pine (Pinus thunbergii).

A number of non-marine mammals, reptiles, amphibians and birds are associated with the dune habitat along the New Jersey coastline. These species include: Fowler's toad (Bufo woodhousei fowleri), eastern hognose snake (Heterodon platyrhinos), box turtle (Terrapene carolina), raccoon (Procyon lotor), eastern cottontail (Sylvilagus floridanus), red fox (Vulpes fulva), white-footed mouse (Peromyscus leucopus), meadow vole (Microtus pensylvanicus), white-tailed deer (Odocoileus virginianus), savannah sparrow (Passerculus sandwichensis), song sparrow (Melospiza melodia), mourning dove (Zenaida macroura), gray catbird (Dumetella carolinensis), northern mockingbird (Mimus polyglottos), and brown thrasher (Toxostoma rufum).

The back bays, Absecon Bay and Lakes Bay, are comprised of open water, a low marsh zone, tidal flats, a high marsh zone, and a transition zone. The low marsh zone is typically dominated by saltmarsh cordgrass (Spartina alterniflora). Tidal flats are areas that are covered with water at high tide and exposed at low tide. They are important areas for algal growth, as producers of fish and wildlife organisms, and as nursery areas for many species of fish, molluscs and other organisms. Dominant species include sea lettuce (Ulva lactuca) and eelgrass (Zostera marina). The high marsh zone which is slightly lower in elevation than the transition zone is dominated by saltmeadow cordgrass and saltgrass (Distichlis spicata). This zone is typically flooded by spring high-tides. Plants typical of the transition zone include both upland and marsh species including marsh elder (Iva frutescens), groundsel-tree (B. halimifolia), bayberry (Myrica spp.), saltgrass (D. spicata), sea-blite (Sueda maritima), glasswort (Salicornia spp.), poison ivy (R. radicans), and common reed (P. australis).

4.6.2 Upper Beach

The upper beach or supralittoral zone typically lies below the primary dune and above the intertidal zone. An upper beach zone is present within the study area, however, it is subject to high disturbance from human activity. The upper beach zone is only covered with water during periods of extremely high tides and large storm waves. The upper beach habitat is characterized by sparse vegetation and few animals. This zone has fewer biological interactions than the dunes, and organic inputs are scarce. The most active organism in this zone is the ghost crab (Ocypode quadrata). This crab lives in semi-permanent burrows near the top of the shore, and it is known to be a scavenger, predator, and deposit sorter. The ghost crab is nocturnal in its foraging activities, and it remains in its burrow during the day. In addition to ghost crabs, species of sand fleas or amphipods (Talitridae), predatory and scavenger beetles and other transient animals may be found in this zone.

Many species of shorebirds inhabit the beach during the spring and fall migrations, although most are even more likely to be found on more protected sand and mud flats, tidal marshes, or along the Delaware Bay shoreline (especially in spring when large numbers of horseshoe crab eggs are available). Shorebirds feed on small individuals of the resident infauna and other small organisms brought in with waves. Common shorebird species include sanderling (Calidris alba), dunlin (C. alpina), semipalmated sandpiper (C. pusilla), western sandpiper (C. mauri), and willet (Catoptrophorus semipalmatus). Sanderling, dunlin, and western sandpiper also occur on the beach throughout the winter. Colonial nesting shorebird habitat is increasingly under pressure from development and human disturbance along New Jersey's Atlantic beaches. Nesting birds such as common tern (*Sterna hirundo*), least tern (*Sterna antillarum*), black skimmer (*Rynchops niger*), and American oystercatcher (*Haematopus palliatus*) are frequent spring and summer inhabitants on unvegetated dunes and upper beaches on Absecon Island.

Several species of gulls are common along New Jersey's shores, and are attracted to forage on components of the beach wrack such as carrion and plant parts. These gulls include the laughing gull (*Larus atricilla*), herring gull (*L. argentatus*), and ring-billed gull (*L. delawarensis*).

4.7 AQUATIC ECOLOGY OF AFFECTED AREA

4.7.1 Upper Marine Intertidal Zone

The upper marine intertidal zone is also primarily barren, however, more biological activity is present in comparison to the upper beach. Organic inputs are derived primarily from the ocean in the form of beach wrack, which is composed of drying seaweed, tidal marsh plant debris, decaying marine animals, and miscellaneous debris that washed up and deposited on the beach. The beach wrack provides a cooler, moist microhabitat suitable to crustaceans such as the amphipods: *Orchestia* spp. and *Talorchestia* spp., which are also known as beach fleas. Beach fleas are important prey to ghost crabs. Various foraging birds and some mammals are attracted to the beach fleas, ghost crabs, carrion and plant parts that are commonly found in beach wrack. The birds include gulls, shorebirds, fish crows, and grackles.

4.7.2 Intertidal Zone

The intertidal zone contains more intensive biological activity than the other zones. Shifting sand and pounding surf dominate a habitat which is inhabited by a specialized fauna. The beach fauna forms an extensive food-filtering system which removes detritus, dissolved materials, plankton, and larger organisms from in-rushing water. The organisms inhabiting the beach intertidal zone have evolved special locomotory, respiratory, and morphological adaptations which enable them to survive in this extreme habitat. Organisms of this zone are agile, mobile, and capable of resisting long periods of environmental stress. Most are excellent and rapid burrowers. Frequent inundation of water provides suitable habitat for benthic infauna, however, there may be a paucity in numbers of species. Intertidal benthic organisms tend to have a high rate of reproduction, and a short (1 to 2 years) life span (Hurme and Pullen, 1988). This zone contains a mixture of herbivores, primary carnivores, and some high order carnivores such as the mole crab (Emerita sp.). A number of interstitial animals (meiofauna) are present feeding among the sand grains for bacteria and unicellular algae, which are important in the beach food chain. In 1978, extensive sampling for invertebrate infauna was performed by the U.S. Fish and Wildlife Service and Corps of Engineers on the beaches within the Delmarva Peninsula, Maryland. There were four dominant species of invertebrate infauna in this zone, which were the mole crab (Emerita talpoida), a haustorid amphipod (Haustorius canadensis), the coquina clam (Donax variabilis), and spionid worm (Scolelepis squamata). The epifaunal blue crab (Callinectes sapidus) and the lady crab (Ovalipes ocellatus) were also found in or near this zone. These species withdraw to the nearshore subtidal zone during the winter months and return to the intertidal zone when conditions are more favorable. These invertebrates are prey to various shorebirds and nearshore fishes such as the Atlantic silverside (Menidia menidia), and juveniles of spot (Leiostomus xanthurus), kingfish (Menticirrhus saxatilus), and bluefish (Pomatomus saltatrix). The horseshore crab (Limulus polyphenus) is a common inhabitant of Atlantic Coastal areas, and utilizes the sandy beaches (particularly of Delaware Bay) to lay eggs.

Benthic macroalgae grow attached to the bottom substrate in the intertidal zone, where they are alternately exposed and submerged as the tides ebb and flow. The substrate along the Atlantic Coast of New Jersey is mainly composed of shifting sands and shell fragments, making it too unstable for large colonies of benthic algae to proliferate. Colonies do attach on hard, stable substrates provided by peat banks, shell bottoms, reefs, and man-made structures such as pilings, jetties, buoys and bridges. Various species of benthic macroalgae representing the phyla Chlorophyta and Phaeophyta are found in New Jersey's coastal waters.

The rock groins located along the Absecon Island oceanfront represent an artificial rocky intertidal zone. In addition to providing a hard substrate for the attachment of benthic macroalgae, the groins also contain suitable habitats for a number of aquatic and avian species. Barnacles, molluscs, small crustaceans, polychaetes, and a variety of shorebirds may reside on, above and around these structures. Mussels (Mytilus sp.) are prevalent on the rock surfaces. These structures are also used by various finfish for feeding and shelter.

4.7.3 Nearshore and Offshore Zones

The nearshore coastal zone generally extends seaward from the subtidal zone to well beyond the breaker zone (U.S. Army Corps of Engineers, 1984). This zone is characterized by intense wave energies that displace and transport coastal sediments. The offshore zone generally lies beyond the breakers, and is a flat zone of variable width extending to the seaward edge of the Continental Shelf. Hurme and Pullen (1988) describe the nearshore zone as an indefinite area that includes parts of the surf and offshore areas affected by nearshore currents. The boundaries of these zones may vary depending on relative depths and wave heights present (Figure 7).

The following paragraphs discuss planktonic, pelagic and benthic biological resources associated with New Jersey coastal waters, which may overlap nearshore waters with offshore waters. The proposed sand borrow sites for this project will be referred to as the proposed offshore borrow sites.

4.7.3.1 Plankton

Plankton are collectively a group of interacting minute organisms adrift in the water column. Plankton are commonly broken into two main categories: phytoplankton (plant kingdom) and zooplankton (animal kingdom).

Phytoplankton play an essential role in the food web because they are the primary producers in the aquatic marine ecosystem. Phytoplankton convert light and chemical energy into organic compounds which can be assimilated by higher organisms in the food chain. Phytoplankton production is dependent on light penetration, available nutrients, temperature and wind stress. Phytoplankton production is generally highest in nearshore waters. Seasonal shifts in species dominance of phytoplankton are frequent. Dinoflagellates are generally abundant from summer through fall, and diatoms are dominant during the winter and early spring. Approximately 126 species of phytoplankton were identified in New Jersey's coastal waters representing the following phyla: Chlorophyta, Chromophyta, Pyrrophyta, Euglenophyta, and Procaryota.

The most prevalent species and their season of dominance are as follows:

Nitzschia seriata - winter
Skeletonema costatum - late winter, early spring
Guinarkia flaccida - spring
Pyramimonas sp. - spring, early summer
Cryptomonas acuta - summer
Katodinium rotundatum - mid-summer
Chrysochromulina sp. - summer

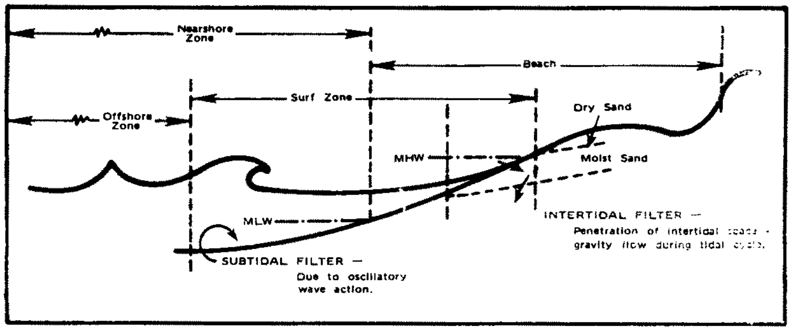


Figure 7. Zonation of beach and nearshore environments.

Zooplankton provide an essential trophic link between primary producers and higher organisms. Zooplankton represent the animals (vertebrates and invertebrates) that are adrift in the water column, and are generally unable to move against major ocean currents. Many organisms may be zooplankton at early stages in their respective life cycles only to be able to swim against the currents (nektonic) in a later life stage, or to be a part of the benthic community. Zooplankton are generally either microscopic or barely visible to the naked eye. Zooplankton typically exhibit seasonal variances in species abundance and distribution, which may be attributed to temperature, salinity and food availability. In marine environments, seasonal peaks in abundance of zooplankton distinctly correlate with seasonal phytoplankton peaks. These peaks usually occur in the spring and fall. Sampling in the lower Delaware Bay by Watling and Maurer (1976) revealed the presence of 60 species representing the following phyla: Protozoa, Cnidaria, Ctenophora, Ectoprocta, Annelida, Mollusca, Arthropoda, Chaetognatha and Chordata. Zooplankton species characteristic of coastal areas include: Acartia tonsa, Centropages humatus, C. furatus, Temora longicornis, Tortanus discaudatus, Eucalanus pileatus, Mysidopsis bigelowi (mysid shrimp), and Crangon septemspinosa (sand shrimp).

4.7.3.2 Macroinvertebrates

The nearshore and offshore zones of the New Jersey Coast contain a wide assemblage of invertebrate species inhabiting the benthic substrate and open water. Invertebrate phyla existing along the coast are represented by Cnidaria (corals, anemones, jellyfish), Platyhelminthes (flatworms), Nemertinea (ribbon worms), Nematoda (roundworms), Bryozoa, Mollusca (chitons, clams, mussels, etc.), Echinodermata (sea urchins, sea cucumbers, sand dollars, starfish), and the Urochordata (tunicates).

The diversity and composition of benthic communities are often reliable indicators of the overall quality of any particular habitat for supporting life (New Jersey Bureau of Fisheries, 1979). Benthic macroinvertebrates are those dwelling in the substrate (infauna) or on the substrate (epifauna). Benthic invertebrates are an important link in the aquatic food chain, and provide a food source for most fishes. Various factors such as hydrography, sediment type, depth, temperature, irregular patterns of recruitment and biotic interactions (predation and competition) may influence species dominance in benthic communities. Benthic assemblages in New Jersey coastal waters exhibit seasonal and spatial variability. Generally, coarse sandy sediments are inhabited by filter feeders, and areas of soft silt or mud are more utilized by deposit feeders.

Sampling associated with the proposed Atlantic Generating Station used clam dredges, trawls, and grab samples to survey the species composition, abundance, weight, and distribution of benthic macroinvertebrates in the vicinity of the Mullica River estuary, Great Bay, Little Egg Inlet, and the ocean from Brigantine Island to Lond Beach Island and 5 miles seaward (Milstein and Thomas, 1976). Over 250 macroinvertebrate species were collected during these surveys. These species included: Aricidea jeffreyssi (paraonid polychaeta), Spiophanes bombyx (spionid polychaeta), Tellina agilis (tellinid bivalvia), Mediomastus ambiseta (capitellid polychaeta), Nephtys picta (nephtyid polychaeta), Unciola irrorata (aorid amphipoda), Paranaitis speciosa (phyllodocid polychaeta), Nucula proxima (nuculid bivalvia), and Ensis directus (solenid bivalvia).

In 1979, the NJ Bureau of Fisheries conducted a benthic study in the inlets from Great Bay to Great Egg Harbor Inlet to inventory benthic organisms and the composition of the sediments in which they lived. The resulting report discussed the relationship of the organisms to sediment composition, as well as the condition of benthic communities in specific substrates. Although some species association was found with certain sediment types, no strong correlations between species diversity and density, and sediment composition were found (Fish and Wildlife Service, 1991).

In October 1994, a benthic-sediment assessment focusing on infauna species was conducted in the proposed offshore sand borrow sites located in Absecon Inlet and offshore of Absecon Inlet, to establish a baseline for the benthic macroinvertebrate assemblages within the proposed borrow site. Other objectives were to identify the presence of any commercial and/or recreationally important benthic macroinvertebrates, and to identify the presence of ecologically important benthic communities within the proposed sand borrow sites. Five control areas were situated around the proposed sand borrow site "A" (Absecon Inlet) and three around borrow site "B" (offshore area) to offer comparisons with the data. Figure 8 identifies the sample locations in relation to the proposed borrow site. The sediments inhabited by the benthic community were very sandy, with sand fractions ranging from 82.1 to 99.8 percent in area "A", and from 73.4 to 99.9 percent in area "B". Sediments from area "A" varied from poorly sorted to very well sorted. Proposed borrow area "B" sediments varied from moderately well sorted to very well sorted (Battelle Ocean Sciences, 1995).

The results of the benthic sampling from the 38 sample locations reveal that borrow area "A" is characterized by relatively low infaunal abundance (mean: 990 individuals/m^2) and low species diversity. Characteristic organisms included haustoriid amphipods, particularly Acanthohaustorius millsi and Protohaustorius sp. B. The archiannelid worm Polygordius was rare in this proposed borrow area. Area "B" was characterized by relatively high infaunal abundance (mean: 1700 individuals/m^2)

and low speices diversity. Characteristic organisms in this area included Polygordius and Protohaustorius sp. B. This study also discovered the presence of the Atlantic surfclam Spisula solidissima at mean densities of about 10-20 individuals/m^2.

Total macrofaunal abundance per station in area "A" ranged from 20 individuals/0.1 m^2 at three stations to 260 individuals/0.1 m^2 at one station. Mean total abundance within borrow area "A" was 99 (± 36) individuals/0.1 m^2. The contribution of major taxinomic groups varied within this area. Arthropods were the predominant component of 13 stations, contributing between 67 and 94% of the individuals present at those stations. Annelid worms were the most numerous major taxon at three stations, ranging from 47-52% of the individuals present. Table 10 shows the abundance of selected taxa within the areas sampled.

Differences in methodology between the present study and some published studies make direct comparison of results inappropriate. However, general comparisons are useful. Total infaunal abundance found during this study may be roughly compared to that found for an offshore sandy area near Delaware Bay (Maurer et al., 1979). The abundance recorded at the borrow areas proposed for Absecon Island (approximately 1400 to 1600 individuals/m^2) are higher than those reported by Maurer et al. (1979) for Hen and Chicken Shoals. They reported abundances ranging from about 100 to 700 individuals/m^2 for stations located at depths similar to those occurring in the Absecon Inlet Area. Samples studied by Maurer et al. (1979) were rinsed over a 1.0-mm mesh sieve while the Absecon samples were rinsed over a 0.5-mm sieve, thus abundances would be expected to be lower. The relative importance of haustoriid amphipods in the benthic communities in the Absecon Inlet area mirrors that found by Maurer et al. (1979). Maurer et al. (1979) also noted that species of haustoriids generally differed in their distribution relative to the shoreline. Acanthohaustorius millsi typically occurred in the nearshore area, while Parahaustorius longimerus occurred further offshore. In the Absecon Inlet areas, both species characterized relatively nearshore stations, while Protohaustorius sp B characterized offshore stations (Battelle Ocean Sciences, 1995). The complete benthic analysis can be found in Appendix A of the Main Report.

Since the time of the 1994 benthic sampling, another borrow area was added as a potential source of sand for this beachfill. This potential borrow area is located just offshore of Great Egg Harbor Inlet (Area C). In addition, another 76 acres were added to area "A" since the original benthic surveys were done. For this reason, a second round of benthic sampling was conducted for these areas in October 1995. In addition to the benthic surveys, a surf clam survey was also done for all three potential borrow areas.

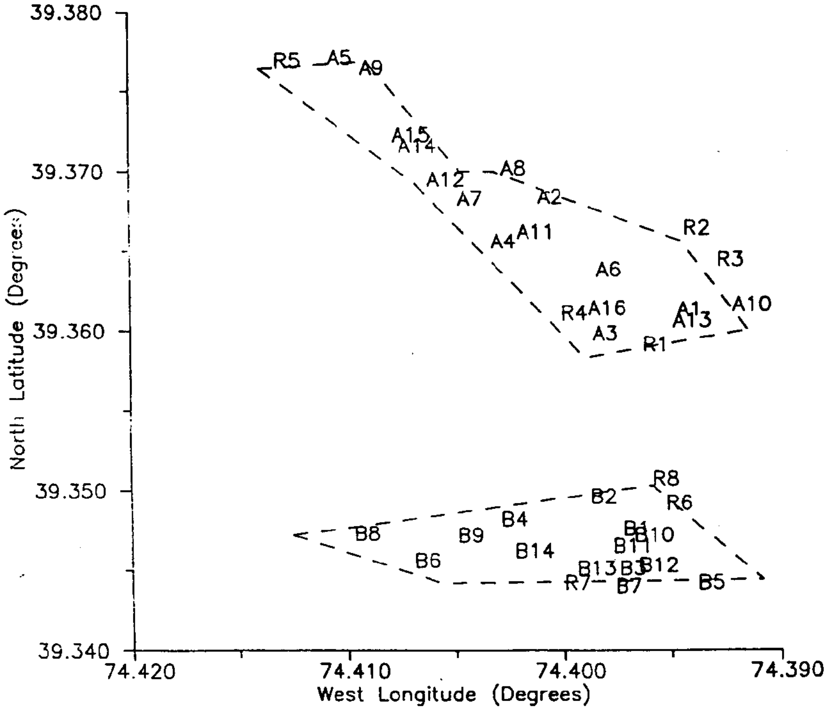


Figure 8
Benthic Sampling Locations

Table 10 Abundance (#/0.1 m^2) of selected taxa in the Absecon Inlet study area, 1994. Mean, standard deviation (STDS), and 95% confidence intervals (CI) are provided.

Species	A-1	A-2	A-3	A-4	A-5	A-6	A-7	A-8	A-9	A-10	A-11	A-12	A-13	A-14	A-15	A-16	Mean	STDS	95% CI
Magelona papillicornis	12	2	3	0	0	15	0	2	0	16	3	0	12	1	0	14	5.0	6.28	3.08
Scolelepis squamata	0	0	0	8	0	3	6	6	0	0	5	0	0	2	0	2	2.0	2.76	1.35
Polygordius	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	1	0.2	0.54	0.27
Capitellidae	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0.1	0.25	0.12
Acanthohaustorius millsi	14	22	24	22	3	43	22	2	4	6	12	37	55	0	2	71	21.2	20.88	10.23
Protohaustorius sp. B	68	8	1	0	0	55	0	0	0	116	0	0	111	0	0	63	26.4	41.90	20.53
Parahaustorius longimerus	0	7	4	36	10	4	59	4	0	0	31	48	2	6	9	2	13.9	18.77	9.20
Haustoriidae	116	58	33	102	15	120	103	8	5	141	63	101	180	7	15	167	77.1	59.49	29.15
Spisula solidissima	0	1	0	3	6	0	9	2	3	0	1	4	0	0	0	0	1.8	2.64	1.29
Pelecypoda sp. F	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	60	4.1	14.97	7.33

Species	B-1	B-2	B-3	B-4	B-5	B-6	B-7	B-8	B-9	B-10	B-11	B-12	B-13	B-14	Mean	STDS	95% CI
Magelona papillicornis	0	34	1	3	35	1	17	14	16	0	0	14	0	0	9.6	12.49	6.54
Scolelepis squamata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0.00	
Polygordius	142	27	9	24	64	0	89	2	19	18	22	262	32	281	70.8	93.32	48.88
Capitellidae	0	12	0	1	0	54	0	1	4	0	0	1	0	0	5.2	14.41	7.55
Acanthohaustorius millsi	0	6	0	0	4	1	2	5	6	0	0	4	0	0	2.0	2.45	1.28
Protohaustorius sp. B	0	87	0	61	26	0	0	41	57	0	1	2	1	1	19.8	29.64	15.53
Parahaustorius longimerus	1	0	3	0	0	0	0	0	0	2	2	4	4	0	1.1	1.56	0.82
Haustoriidae	1	111	3	68	39	1	7	47	70	3	4	27	8	2	27.9	34.57	18.11
Spisula solidissima	3	1	5	4	6	0	1	1	1	1	2	2	0	5	2.3	1.98	1.04
Pelecypoda sp. F	12	85	7	0	31	5	22	16	72	7	2	41	6	3	22.1	26.73	14.00

Species	R-1	R-2	R-3	R-4	R-5	R-6	R-7	R-8	Mean	STDS	95% CI
Magelona papillicornis	7	23	18	13	0	1	21	9	11.5	8.75	6.06
Scolelepis squamata	0	0	0	0	0	0	0	0	0.0	0.00	
Polygordius	0	0	2	0	5	33	38	3	10.1	15.82	10.96
Capitellidae	0	1	0	0	0	13	0	0	1.8	4.56	3.16
Acanthohaustorius millsi	49	30	15	32	0	0	10	5	17.6	17.69	12.26
Protohaustorius sp. B	23	131	98	17	0	0	1	97	45.9	53.66	37.18
Parahaustorius longimerus	5	1	0	4	0	0	2	0	1.5	2.00	1.39
Haustoriidae	87	180	127	81	0	0	19	102	74.5	64.39	44.62
Spisula solidissima	0	0	3	1	2	0	0	0	0.8	1.16	0.81
Pelecypoda sp. F	22	10	27	31	0	0	9	73	21.5	23.86	16.54

During the 1995 sampling, 13 stations were sampled within the proposed borrow areas as well as the surrounding areas (Figure 9). The results of this benthic analysis indicate a relatively low species richness in both borrow areas with the mean number of species not exceeding 11 in either borrow area. No significant differences were found between the borrow areas, between the borrow areas and the nearshore reference areas, or between the borrow areas and the Bight Apex area which was used as a reference (Versar, 1996). The abundance of species within the borrow areas was also relatively low, less than 2,000/m^2 (Table 11). Again, no statistically significant differences were detected between the borrow areas or between the borrow areas and the nearshore reference area. Total abundance in the Bight Apex area was significantly greater than in the borrow areas, by a factor of 17 to 40 (Versar, 1996). The difference is mostly due to a large abundance of a bivalve and two polychaetes in the Bight Apex area. These species are *Nucula annulata* (3,970/m^2), *Polygordius* spp. (13,006/m^2) and *Prionospio steenstrupi* (5,046/m^2).

The Versar report concluded that, except for the presence of surf clams, no significant attributes of the benthic community at the proposed borrow areas favor the selection of one borrow area over another. Also, measures of benthic community condition did not vary substantially between the proposed borrow areas and any of the reference sites in a way that would preclude the use of the areas.

The surf clam survey was conducted using a commercial hydraulic clam dredge equipped with a 72 inch knife to determine the abundance of clams in each borrow area. The areas were surveyed by conducting 3 five-minute tows within each proposed borrow area (Table 12). The results of these tows indicate that commerically harvestable quantities of clams exist within these areas. The highest concentration was found in area "B", where between 25 and 50 bushels of clams were collected during the 5-minute tows. The average number of clams per bushel was 156. The Great Egg Harbor borrow area "C", had numbers ranging from 11 to 40 bushels per tow, with an average of 232 clams per bushel. Potential borrow area "A" produced between 15 and 23 bushels per tow with an average of 145 clams per bushel (Versar, Inc., 1995). Figure 10 shows the size and age distribution of the sampled population. In borrow areas A and C, the size of the clams, in terms of lenght appears relatively evenly distributed in the range of 7-13 cm. Borrow area B however appears to contain a population between 5-10 years old with the average length 9-10 cm (Jones, et al., 1978).

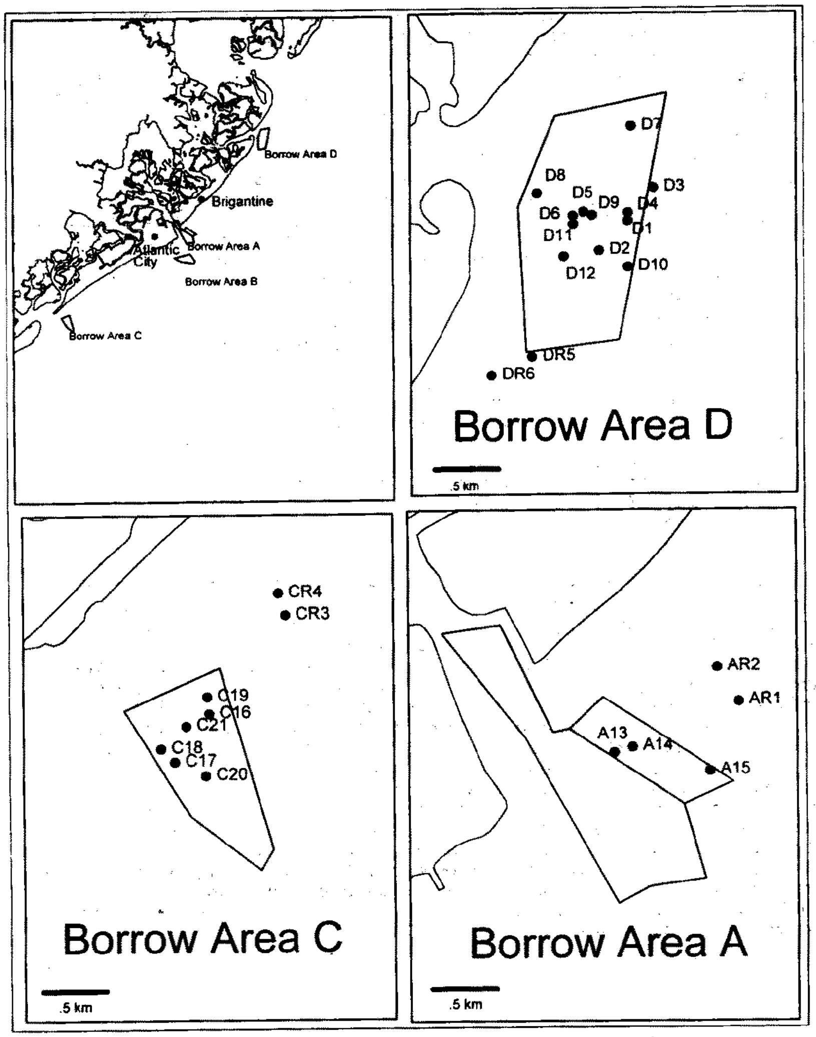


Figure 9
1995 Sample Locations

Mean abundance (#/m^2) of selected taxa at the borrow areas

Species	Borrow D	Borrow A	Borrow C	Nearshore Reference	Bight Apex Reference
Nemertinea					
Nemertinea	7.58	7.58	11.36	15.15	90.49
Annelida : Polychaeta					
Ampharetidae	0	0	0	0	2,433.08
Apoprionospio pygmaea	0	22.73	7.58	18.94	0.84
Aricidea catherinae	0	0	0	0	513.47
Dispio uncinata	5.68	22.73	22.73	3.79	0
Euchone incolor	0	0	0	0	320.71
Lumbrineridae	0	0	0	0	327.86
Magelona spp.	28.41	53.03	155.30	64.39	31.99
Polygordius spp.	0	0	0	3.79	13,005.89
Prionospio steenstrupi	0	0	0	0	5,045.88
Tharyx sp. A Morris	0	0	0	0	411.20
Annelida : Oligochaeta					
Oligochaeta	0	0	0	3.79	911.20
Mollusca : Gastropoda					
Nassarius trivittatus	0	15.15	7.58	3.79	5.89
Mollusca : Bivalvia					
Donax variabilis	39.77	37.88	0	0	0
Nucula annulata	0	0	0	0	3,969.70
Petricola pholadiformis	0	0	0	15.15	0.84
Spisula solidissima	22.73	83.33	37.88	250.00	145.62
Tellina agilis	0	15.15	15.15	7.58	171.72
Arthropoda : Mysidacea					
Neomysis americana	1.89	7.58	0	18.94	0.84
Arthropoda : Tanaidacea					
Tanaissus psammophilus	1.89	15.15	11.36	0	52.19
Arthropoda : Isopoda					
Chiridotea coeca	18.94	0	0	0	0
Chiridotea tuftsi	0	0	11.36	0	0
Edotea triloba	1.89	22.73	30.30	11.36	16.84
Arthropoda : Amphipoda					
Acanthohaustorius millsi	54.92	431.82	181.82	231.06	1.26
Acanthohaustorius spp.	18.94	0	0	0	1.26
Ampelisca agassizi	0	0	0	0	281.57
Batea catharinensis	0	0	0	18.94	0
Bathyporeia quoddyensis	206.44	0	3.79	0	0
Bathyporeia spp.	9.47	7.58	11.36	7.58	0
Cerapus tubularis	0	0	0	90.91	0
Parahaustorius attenuatus	24.62	0	3.79	0	0
Parahaustorius longimerus	143.94	0	0	0	0
Parahaustorius spp.	172.35	0	7.58	0	0
Protohaustorius cf. *deichmannae*	28.41	1,106.06	1,261.36	795.45	60.61
Rhepoxynius hudsoni	0	0	11.36	0	65.24
Synchelidium americanum	0	7.58	11.36	15.15	0.42
Arthropoda : Decapoda					
Pagurus longicarpus	0	0	11.36	0	1.26

Table 11
1995 Sample Results

RESULTS OF THE BRIGANTINE CLAM SURVEY CONDUCTED ON OCTOBER 25, 1995

BORROW AREA	LATITUDE	LONGITUDE	STATION	# OF CLAMS/ BUSHEL	# of BUSHELS	TOTAL CLAMS	DISTANCE TOWED (METERS)	DENSITY (CLAMS/M²)
BRIGANTINE INLET	39 26.42	74 18.38	D1	172	1.8	303.3	238	0.7
	39 26.58	74 18.26	D3	183	1.1	183.4	194	0.5
	39 26.26	74 18.45	D10	165	1.5	256.5	331	0.4
			AVG #	173.3				0.6
ABSECON INLET								
	39 21.78	74 23.27	A13	147	22	3182.7	272	6.4
	39 21.82	74 23.12	A14	148	15	2170	249	4.8
	39 21.72	74 23.03	A15	139	23	3327.3	310	5.9
			AVG #	144.7				5.7
ABSECON ISLAND OFF SHORE								
	39 20.56	74 23.98	B22	156	50	7800	307	13.9
	39 20.47	74 23.50	B23	112	37	5772	261	12.1
	39 20.59	74 24.06	B24	200	25	3900	217	9.8
			AVG #	156				11.9
GREAT EGG HARBOR INLET								
	39 17.74	74 30.91	C16	235	40	9280	264	19.2
	39 17.64	74 30.99	C17	221	11	2552	173	8.1
	39 17.63	74 31.01	C18	240	13	3016	125	13.2
			AVG #	232				13.5

Table 12
Results of Clam Survey

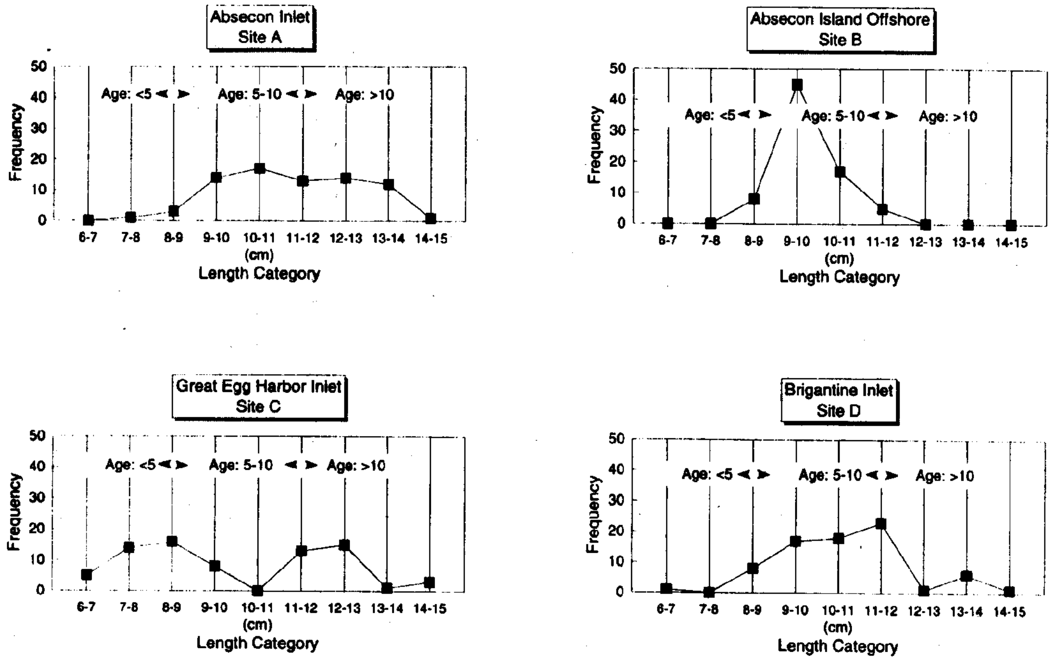


Figure 10
Size and Age Distribution of Surf Clams

4.7.3.3 Fisheries

4.7.3.3.1 Shellfish

Extensive shellfish beds, which fluctuate in qulaity and productivity are found in the back bays and shallow ocean waters of the study area. Surf clams (Spisula solidissima) are found offshore the barrier islands along with hard clams (Mercenaria mercenaria), blue mussel (Mytilus edulis) and blue crab (Callinectes sapidus). Since many of these animals are filter feeders and tend to bioaccumulate toxins and bacteria within their systems, bivalves are often used as indicators of water quality. Indications of this can be seen when shellfish areas are closed or have restricted harvests. In areas where this occurs, there are generally water quality or pollution problems associated with the closings.

The area between Little Beach and Absecon Inlet from the surf to one nautical mile off-shore has been designated a conservation zone by the Surf Clam Advisory Committee. This joint committee was formed by the N.J. Bureau of Shellfisheries and representatives of the commercial surf clam industry, to determine harvesting regulations. No surf clam harvesting is allowed within a conservation zone in order to promote recruitment and growth of current stock (U.S. Fish and Wildlife Service, 1991).

The waters behind Absecon Island and in the vicinity of Absecon Inlet are seasonal or special restricted. In special restricted areas, the waters are condemned for the harvest of oysters, clams, and mussels, except harvesting for further processing may be done under special permit from the New Jersey Department of Environmental Protection. Licensed clammers are allowed to relay clams to Great Bay where they cleanse themselves in purer waters. At the northern half of the island, the waters are classified as prohibited, and are condemned for the harvest of oysters, clams, and mussels from the shoreline to a distance between 0.25 miles and 2 miles. Most of Little Bay, Grassy Bay, and Reed Bay, except for isolated areas, are approved for shellfish harvest.

The surf clam fishery supports the largest molluscan fishery in New Jersey, accounting for, by weight, 52% of the State's total molluscan commercial landing in 1993. This catch represents over 85% of the total Mid-Atlantic area catch for 1993, with a value of over 21 million dollars (N.J. Bureau of Shellfisheries, 1994).

A study conducted from July 1989 to June 1990 surveyed the standing stock of surf clams in New Jersey (Ward, 1990). This study investigated size composition, abundance, and recruitment within the New Jersey surf clam population. In 1989, the harvest zones between Barnegat Inlet and Absecon Inlet were estimated to contain over 3 million bushels of surf clams, or 40% of the state's standing stock (Fish and Wildlife, 1991).

According to data from New Jersey's Bureau of Shellfisheries 1993 annual surf clam inventory project, the total surf clam standing stock for New Jersey territorial waters was 12,195,000 bushels. This number represents a decrease of 775,000 bushels from 1992. Surf clam harvest records indicate that most of the harvesting activity (42%) in New Jersey occurred in the middle mile between Absecon Inlet and Barnegat Inlet. During the 1993-1994 season, over 600,000 bushels of surf clams were harvested (N.J. Bureau of Shellfisheries, 1994).

The hard clam is the most economically important shellfish of the back bays, supporting both commercial and recreational fisheries (N.J. Bureau of Fisheries, 1979). Although data on exact locations and densities of adult hard clams within the project area is limited, they are known to be found in the intertidal and subtidal zones of bays and lower estuaries. A hard clam survey conducted in 1990 found areas with moderate (0.20 - 0.49 clams/sq. ft.) to high densities ($\geq$ 0.50 clams/sq. ft.) in the areas behind Brigantine Island (Joseph, 1990).

In addition to supporting some of the best hard clam resources in the State, the bays in the project area also support other species of shellfish (N.J. Bureau of Fisheries, 1979). American oysters are not usually present in commercially harvestable densities, but can be found throughout the project area. Soft clams and blue mussels are primarily harvested for recreation, but occasionally commercial densities are present (Fish and Wildlife, 1991).

4.7.3.3.2 Finfish

The proximity of several embayments allows the coastal waters of New Jersey to have a productive fishery. Many species utilize the estuaries of Absecon Bay, Reeds Bay and Lakes Bay for forage and nursery grounds. The finfish found along the Atlantic Coast of New Jersey are principally seasonal migrants. Winter is a time of low abundance and diversity as most species leave the area for warmer waters offshore and southward. During the spring, increasing numbers of fish are attracted to the New Jersey Coast, because of its proximity to several estuaries which are utilized by these fish for spawning and nurseries.

A study, conducted from March to December 1977 by John F. McClain and presented in "Studies of the Back Bay Systems in Atlantic County," indicates that the back bays of the Atlantic City area provide a high quality habitat for many species of fish. Fifty-nine species of fish, including bay anchovy (Anchoa mitchilli), weakfish (Cynoscion regalis), spot (Leiostomus xanthurus), windowpane (Scophthalmus aquosus), red hake(Urophycis chuss), winter flounder (Psuedopleuronectes americanus), small mouth flounder (Etropus microstomus), oyster toadfish (Opsanus tau) and Atlantic silverside (Menidia menidia), were among the species utilizing this habitat. The fish species caught in the back bays during this study are summarized in Table 13.

Sampling was conducted by gill net, seine and trawl. The bay anchovy was present at all trawl stations and dominant in six of them, while the seine samples were dominated by the Atlantic silverside at all stations except one. The fish species and their relative abundance were found to be similar to those reported in studies for Great Bay and Brigantine National Wildlife Refuge, now the Forsythe National Wildlife Refuge, (Icthyological Associates, 1974 and 1975), and the Delaware Bay (Daiber, 1974). The five most abundant species were Atlantic silverside, bay anchovy, spot, mummichog (3%) and striped killifish (1%).

During a 1977 ichthyoplankton study, conducted by Peter Himchak and presented in "Studies of the Back Bay Systems in Atlantic County", twenty species of larval and young finfish were found to utilize the backbays in the vicinity of Atlantic City as a nursery area. These include species endemic to estuaries as well as marine species that utilize the back bays as nursery grounds. Over 80 percent of the catch was comprised of members of the Gobiidae and Engravlidae Families. Approximately 15 percent of the total catch was comprised of naked gobies (Gobiosoma bosci), Northern pipefish (Syngnathus fuscus), weakfish (Cynoscion regalis), and bay anchovies (Anchoa mitchilli).

From 1972 to 1975, an intensive ecological study was conducted for the proposed Atlantic Generating Station (U.S. Fish and Wildlife Service, 1991). Trawl surveys between Holgate Peninsula and Brigantine Inlet collected 69 species in 1972, and 76 species in 1973 and 1974. The most abundant fish taken for all years included bay anchovy (Anchoa mitchilli), red hake (Urophycis chuss), windowpane flounder (Scophthalmus aquosus), weakfish (Cynoscion regalis), spotted hake (Urophycis regia), and silver hake (Merluccius bilinearis).

One hundred seventy-eight species of saltwater fishes are known to occur in waters of nearby Peck Beach. Of these, 156 were from nearshore waters. Of the 124 species recorded in nearby Great Egg Harbor Inlet, 28 are found in large number in offshore waters.

Table 13. Fish Species Caught in the Back Bays of Atlantic City-
March-December 1977.

Species	Scientific Name
Haddock	*Melanogrammus aeglefinus*
Mummichog	*Fundulus heteroclitus*
American Sand Lance	*Ammodytes americanus*
Black sea bass	*Centropristis striata*
Northern pipefish	*Syngnathus fuscus*
White Hake	*Urophycis tenuis*
Spot	*Leiostomus xanthurus*
Striped sea robin	*Prionotus evolans*
Weakfish	*Cynoscion regalis*
Winter flounder	*Psuedopleuronectes americanus*
Striped killifish	*Fundulus majalis*
American eel	*Anguilla rostrata*
Northern sea robin	*Prionotus carolinus*
Smallmouth flounder	*Etropus microstomus*
Striped mullet	*Mugil cephalus*
Striped anchovy	*Anchoa hepsetus*
Atlantic menhaden	*Brevoortia tyrannus*
Spotted hake	*Urophycis regius*
Northern stingray	*Dasyatis sp.*
American shad	*Alosa sapidissima*
Banded killifish	*Fundulus diaphanus*
Threespine sticklebak	*Gasterosteus aculeatus*
Permit	*Trachinotus falcatus*
Crevalle jack	*Caranz hippos*
Fourspine stickleback	*Apeltes quadracus*
Orange filefish	*Aluterus schoepfi*
Pollock	*Pollachius virens*
Bay anchovy	*Anchoa mitchilli*
Cunner	*Tautogolabrus adspersus*
Northern puffer	*Sphoeroides maculatus*
Smooth dogfish	*Mustelus canis*
Striped cusk eel	*Rissola marginata*
Summer flounder	*Paralichthys dentatus*
Windowpane	*Scophthalmus aquosus*
Atlantic roasker	*Micropogon undulatus*
Red Hake	*Urophycis chuss*
Blueback herring	*Alosa aestivalis*
Lookdown	*Selene vomer*
Oyster toadfish	*Opsanus tau*
Striped burrfish	*Chilomycterus schoepfi*
Bluefish	*Pomatomus saltatrix*
Alewife	*Alosa pseudoharengus*
Hardtail	*Caranx crysos*
Hogchoker	*Trinectes maculatus*
White perch	*Morone americana*
Atlantic silverside	*Menidia menidia*
Sheepshead minnow	*Cypinodon variegatus*

4.7.4 Inland Bays

Like many of the barrier islands along the coast of New Jersey, the Absecon Island study area is bordered by inland embayments. The two embayments which are located on the western side of Absecon Island are Absecon Bay and Lakes Bay. The inland bays are bordered extensively with tidal marshes composed of saltmarsh cordgrass (Spartina alterniflora), saltmeadow hay(S. patens), spike grass (Distichlis spicata), and high tide bush (Iva frutescens).

Common estuarine fishes present in the inland bays include: bay anchovy (Anchoa mitchilli), Atlantic silverside (Menidia menidia), mummichog (Fundulus heteroclitus), striped killifish (Fundulus majalis), naked goby (Gobiosoma bosci), and hogchoker (Trinectes maculatus). The inland bays are important nurseries for a variety of commercial and recreational fishes including: spot, croaker, weakfish, menhaden, bluefish, and summer flounder. The bays support adequate numbers of hard clam (Mercenaria mercenaria) and blue crab (Callinectes sapidus) for recreational and/or commercial fisheries. The inland bays are also important for supporting a variety of waterfowl, shorebirds, and wading birds.

4.8 ENDANGERED AND THREATENED SPECIES

Federally designated endangered and threatened species found within the study area include the endangered bald eagle (Haliaeetus leucocephalus), peregrine falcon (Falco peregrinus), Kemp's Ridley turtle (Lepidochelys kempii), hawksbill turtle (Eretmochelys imbricata), leatherback turtle (Dermochelys coriacea); and the threatened piping plover (Charadrius melodus), green turtle (Chelonia midas), and loggerhead turtle (Caretta caretta). Peregrines utilize coastal beaches and salt marshes within the study area extensively during migration, and to a lesser extent in summer and winter. Migrating and overwintering bald eagles utilize the study area's coastal marshes where they feed on waterfowl. However, no eagles are known to nest in the area. The highest plover use occurs on the southern tip of Brigantine Island along Absecon Inlet, and the adjacent ocean-front beaches.

A number of Federal or State endangered or threatened species may occur in the vicinity of the study area. Eleven threatened or endangered bird species may occur within the study area. The State endangered species occurring in the Atlantic City area include osprey (Pandion haliaetus), least tern (Sterna albifrons), and black skimmer (Phynchops nigra). The Federally endangered peregrine falcon (Falco peregrinus), and bald eagle (Haliaeetus leucocephalus), along with the State endangered Cooper's hawk (Accipiter cooperi) are migrant species. The State threatened species include marsh hawk (Circus hudsonius) and short-eared owl (Asio flammeus) as winter residents, the pied-billed grebe (Podilymbus podiceps) and great blue heron (Ardea herodias) as both winter and summer residents, and the migrant merlin (Falco columbarius).

Several species of threatened or endangered sea turtles and whales occur in the coastal and nearshore waters of the study area, although all are transients. The endangered hawksbill turtle (Eretmochelys imbricata), leatherback turle (Dermochelys coriacea), and Atlantic ridley turtle (Lepidochelys kempii), and the threatened loggerhead turtle (Caretta caretta), and green turtle (Chelonia mydas) are five species of sea turtles believed to occur in the nearshore waters of the Atlantic Ocean and bay waters. Six species of endangered whales migrate through the North Atlantic and may be found off the coast of New Jersey. These are the blue whale (Balaenoptera physalus), finback whale (Balaenoptera physalus), humpback whale (Megaptera novaeangliae), right whale (Eubalaena spp.), sei whale (Balaenoptera borealis), and sperm whale (Physeter catodon).

4.9 WILDLIFE RESOURCES

Marsh complexes along the New Jersey coast provide a valuable nesting habitat for the seabird population, including the common tern (Sterna hirundo). Common species occupying dredged material disposal areas, especially older sites that have been revegetated, are the least tern (Sterna albifrons), great black-backed gull (Larus marinus), herring gull (Larus argentatus), and the gull-billed tern (Gelocheliodon nilotica), which seek out those sites that have reverted to saltmarsh. Since the least tern is limited to a sandy substrate, unvegetated dredged material islands provide an alternative to barrier island beach habitats. The common tern occupies marsh habitats almost exclusively, while the laughing gull is found on both marsh and disposal sites. Although extensive development and disturbance of the natural conditions of the barrier islands has made this habitat the least utilized, wading birds, such as the great egret (Casmerodius albus), black-crowned night heron (Nycticorax nycticorax), and yellow-crowned night heron (Nyctanassa violacea), are known to inhabit the barrier islands. The snowy egret (Leucophoyx thula), glossy ibis (Plegadis Falcinellus) and little blue heron (Florida caerulea) occupy dredged material islands. Wading birds will typically arrive in mid-March and remain until mid-fall, when they travel south.

The New Jersey coast in the vicinity of the study area is also known as an important wintering ground for a number of waterfowl species. Species include the Atlantic brant (Branta bernicla), black duck (Anas rubripes), Canada goose (Branta canadensis), snow goose (Chen hyperborea), widgeon (Marela americana), scaup (Aytha spp.) and scoter (Melanitta spp.). Over 35 percent of the Atlantic Flyway American black duck (A. rubripes) wintering population utilizes the coastal marshes of New Jersey.

A 1989 survey of the Atlantic coast of New Jersey found 14 species of colonial waterbirds nesting in 39 separate colonies in the Reeds Bay/Absecon Bay area. The survey noted that black-crowned and yellow-crowned night heron populations have declined in the last decade, while egret, ibis, and gull populations have remained stable or increased (U.S. Fish and Wildlife Service, 1991).

Several species of marine mammals, such as the harbor seal (Phoca vitulina), grey seal (Halichoerus grypus), ringed seal (P. hispida), harp seal (P. groenlandica), and hooded seal (Cystophora cristata), are occasionally seen in the bay areas between December and June. Bottle-nosed dolphin (Tursiops truncatus) are commonly seen in Absecon Inlet in the summer, while striped dolphin (Stenella coeruleoalba) and harbor porpoise (Phocoena phocoena) are occasionally observed in the spring. Other marine mammals that occur in the area include right whale (Balaena glacialis), pilot whale (Globicephela macrorhynchus), pygmy sperm whale (Kogia breviceps), Atlantic white-sided dolphin (Lagenorhynchus acutus), and Risso's dolphin (Grampus griseus).

According to studies conducted at the Forsythe National Wildlife Refuge, mammals occurring along streams and on the marsh near woodlands, in and around the study area, include the opossum (Didelphia marsupialis), shorttail shrew (Blarina brevicauda), least shrew (Cryptotis parva), starnose mole (Condylura cristata), and masked shrew (Sorex cinereus). Bat species sighted along watercourses and in wooded areas include the little brown bat (Myotis lucifugus), silver-haired bat (Lasionycteris noctivagans), Eastern pipstrel (Pipistrellus subflavus), big brown bat (Eptescius fuscus), and red bat (Lasiurus cinereus). Upland fields and woodlands support the Eastern chipmunk (Tamias striatus), Eastern cottontail (Sylvilagus floridanus), various mice and vole species, muskrat (Ondatra zibethicus), raccoon (Procyon lotor), longtail weasel (Mustela frenata) and mink (Mustela vison). In addition, gray fox (Urocyon cinereoargenteus) and river otter (Lutra canadensis) have been identified on colonial seabird islands.

A number of upland and fresh water species of reptiles and amphibians occur in the study area. Common reptiles include the following turtles and snakes: the snapping turtle (Chelydra serpentina), stinkpot (Sternothaerus odoratus), Eastern mud turtle (Kinosternos subrubum), Eastern box turtle (Terrapene carolina), diamond back terrapin, Eastern painted turtle (Chrysemys picta), northern watersnake (Natrix sipedon), Eastern garter snake (Thamnophis sirtalis), Northern black racer (Coluber constrictor), and Northern redbellied snake (Storeria occipitomaculata). The redbacked salamander (Plethodon cinereus), four-toed salamander (Hemidactylium scutatum), Fowler's toad (Bufo woodhousei), Northern spring peeper (Hyla crucifer), New Jersey chorus frog (Pseudarcrus triseriata), green frog (Rana utricularia), and Southern leopard frog (Rana pipiens) are all common species of amphibians found in the area.

4.10 CULTURAL RESOURCES

In preparing the FEIS, the Corps has consulted with the New Jersey State Historic Preservation Office (NJSHPO) and other interested parties to identify and evaluate historic properties in order to fulfill its cultural resources responsibilities under the National Historic Preservation Act of 1966, as amended through 1992, and its implementing regulations, 36 CFR Part 800. As part of this work, cultural resources investigations were conducted in the project area. The results of these studies are presented in a draft report entitled "A Phase 1 Submerged and Shoreline Cultural Resources Investigation, Absecon Island, Atlantic County, New Jersey" (Cox and Hunter, 1995) and in an executive summary entitled "Phase 1 and 2 Submerged and Shoreline Cultural Resources Investigation, Brigantine to Hereford Inlet, Atlantic and Cape May Counties, New Jersey" (Cox 1995)(see Appendix A of the Main Report). Section 106 consultation with the NJSHPO for project review has been completed (see Appendix D). The following discussion is taken largely from the above referenced draft reports.

4.10.1 Prehistoric Resources.

The prehistoric occupation of the barrier islands and adjacent Atlantic coastal regions has been categorized by archaeologists into three general periods of cultural development: Paleo-Indian (15,000 years before present (B.P.) - 8,500 B.P.), Archaic (8,500 B.P. - 5,000 B.P.), and Woodland (5,000 B.P. - 400 B.P.). The Paleo-Indian period is the time of the earliest human occupation of the region. Evidence of Paleo-Indian occupation in New Jersey is generally in the form of isolated fluted point sites. This is partly due to the low population density and nomadic lifestyle of the people from the period, as well as from the inundation of sites by sea level rise. Absecon Island was not a coastal location at the time of Paleo-Indian occupancy, but was the site of inland forest/riverine habitats. The shoreline achieved its current location approximately 3,000 years ago.

Archaic period peoples responded to the changing environmental conditions of the post-Pleistocene by exploiting a greater variety of resources. Archaeological investigations have shown that Archaic period sites tend to be relatively small, suggesting short-term and intermittent occupations in areas adjacent to interior freshwater swamps and bay/basin locations. Coastal tidal salt marshes and estuarine environments remained food resource-rich habitats available for exploitation. The prehistoric period that is best represented is the Woodland period, which is characterized by the introduction of pottery, increasing cultural diversity, and the evolution of a sedentary lifestyle that increasingly relied on agriculture. Woodland period culture remained intact until European contact. Woodland period sites have been identified on both the coastal marshes and in the mid-drainage areas in the region. Archaeological sites from this period produce distinctive ceramic forms and small triangular projectile points indicative of bow-and-arrow technology. There are no reported prehistoric sites within the current limits of the project area. The closest known sites are located more than three miles from Absecon Island in Pleasantville and near Linwood.

4.10.2 Historic Resources.

European settlement in the Absecon Island vicinity was informally initiated by Swedish pioneers in the mid-17th century when the small hamlet Lower Bank was established within 20 miles of Atlantic City on the north side of Mullica River. The first formal land surveys in the vicinity of Absecon Island were conducted at the end of the 17th century. In a 1695 survey, Absecon Inlet is referred to as "Graverads Inlet". The region soon developed a strong shipbuilding tradition. Census records indicate that by 1850 shipbuilding was the leading "mechanical business" being conducted at Absecon. The small schooner, especially suited for the lumber and charcoal trade, was the leading ship type built in the region.

Prior to the completion of the Camden and Atlantic Railroad in 1854, Absecon Island remained largely undeveloped. Jeremiah Leeds and his family owned much of Absecon Island up to the mid-19th century, when his heirs began selling property to the Camden and Atlantic Railroad Company for resort-based residential development. The C & A Railroad completed the rail connection from Camden to Absecon Island in 1854. A bridge was completed the following year connecting the barrier island to the main land. The impact of the C & A Railroad and other railroads that followed was dramatic. Multiple rail access effectively enabled Atlantic City to emerge as New Jersey's premier resort location. By 1900, the island had a population of 28,000. Longport and South Atlantic City continued to expand and the city of Ventnor became well established.

The original idea for the Atlantic City boardwalk dates to 1870 when the City Council passed a resolution to build the first boardwalk. This first structure was elevated 18 inches above the sand and could be disassembled and put in storage during the winter months. The first permanent boardwalk was erected in 1884 and was the first such structure to be equipped with electricity. The present ocean-front structure, composed of steel pilings and steel girders, is the fifth boardwalk, and was built by the Phoenix Bridge Company in 1939. As early as the 1880's, the prospect of entertainment piers extending from the boardwalk out into the sea was envisioned. The Steeplechase Pier, first known as the Auditorium Pier, was constructed in 1899. It was rebuilt in 1904 to include a bandshell and was totally rebuilt following a fire in 1932. In the 1960's it became the first amusement pier to reintroduce the roller coaster as an attraction. The Garden Pier was built between 1912 and 1914, and supported 25 stores and a large four-towered building containing a ballroom, a theater and an exhibition hall centered around a garden court. In 1940, after years of financial problems, the city took possession of the pier and converted it into a new civic center in 1955.

Atlantic City prospered into the first quarter of the 20th century. In 1920 the Convention Hall was opened and became the National Headquarters of the Miss America Pageant. The surging economy of Atlantic City encountered its first major setback when the stock market crashed in 1929. The city was devastated and, to this day, has yet to fully recover its former glory as the nation's premiere sea-side resort. The city is currently relying on casino gambling as the basis for economic recovery, however, the city's permanent population has been in steady decline, while that of the neighboring towns of Ventnor, Margate and Longport has been increasing.

4.10.3 Maritime History

Absecon Inlet was developed as the harbor for Atlantic City in the late 19th century. Although merchants in the region had long used the inlet to transport lumber, ice, coal, brick, stone, oysters and other items to and from the various beachfront and interior communities, by the end of the 19th century the inlet was principally used by pleasure and fishing craft. Navigational improvements to the inlet were not completed until the late 19th century, and navigation through the high-energy environment of the inlet remained treacherous throughout this period. Coastal storms rapidly moved sand in and out of the inlet, causing severe hazards to shipping. The U.S. Army Corps of Engineers constructed a jetty on the northeast side to stabilize the channel, and also dredged the channel to a depth of 12 feet in 1912.

Although there are no major Atlantic coastal ports in New Jersey, there has been a consistently high volume of ship traffic passing up and down the coast in route to the port cities in New York Bay and Delaware Bay throughout the historic period. The barrier beaches and inlets along the 127-mile New Jersey coastline offer little relief to mariners in distress, and

Absecon Inlet was one of only a few suitable harbors in which to seek refuge. Entering the inlet during a coastal storm was quite hazardous, and a number of vessels have been documented as being lost in the vicinity. Over three hundred vessels have been wrecked on the shoals off Brigantine and Absecon Islands since the late 1700's. Coastal storms, treacherous northeast winds and swift tidal currents, coupled with historically heavy coastal traffic, has caused the documented loss of dozens of sailing vessels, steamships, barges, tugs and large modern ships off the New Jersey Coast. A variety of potential submerged cultural resources in the project vicinity could date from the first half of the 17th century through the Second World War. The 1990 NOAA chart and U.S.G.S. quadrangle maps for the project area show numerous shipwreck sites on the shoals and just off the shoreline. Federal funding for navigation aids and life saving stations occurred in the 19th century. In 1857 the Absecon Lighthouse was constructed at the northeast end of Atlantic City. The first Federal appropriation for lifesaving stations in New Jersey occurred in 1848, when $10,000 was set aside to provide lifeboats and rockets for eight lifeboat stations. By 1900 there were 42 lifesaving stations on the New Jersey coast at an average of three miles apart. Absecon Island had three lifesaving stations - numbers 27, 28 and 29. Station records from 1886 to 1897 show that 139 vessels were in distress off Absecon Inlet during those 11 years.

4.10.4. National Register Properties

There are numerous historic properties listed on the National Register of Historic Places within the general project vicinity. These include the Absecon Lighthouse and several hotels, apartment buildings, churches, and the Marvin Gardens Historic District. Two properties, the Atlantic City Convention Hall and Lucy, the Margate Elephant, have been designated National Historic Landmark status.

4.10.5. Cultural Resources Investigations

The Philadelphia District conducted two cultural resources investigations for the project in 1995. In the first study, entitled "A Phase 1 Submerged and Shoreline Cultural Resources Investigation, Absecon Island, Atlantic County, New Jersey (Cox and Hunter 1995), researchers investigated two offshore borrow areas and an eight-mile segment of tidal zone shoreline along Absecon Island. Magnetometer, side-scan and bathymetric data analysis identified 5 potentially significant underwater resources in the Absecon Inlet Borrow Area. No targets of any kind were identified in the Offshore Borrow Area. The shoreline survey identified two historic entertainment piers that are potentially eligible for listing in the National Register of Historic Places - the Steeplechase Pier and the Garden Pier.

In the second study, submitted as an executive summary entitled "A Phase 1 and 2 Submerged and Shoreline Cultural Resources Investigation, Brigantine Inlet to Hereford Inlet, Atlantic and Cape May Counties, New Jersey" (Cox 1995), archaeologists conducted an additional remote sensing survey in the borrow area at Absecon Inlet, a remote sensing survey at a new offshore borrow area at Longport, and underwater ground truthing operations at selected high probability target locations in the Absecon Borrow Area. This second remote sensing survey identified two additional and potentially significant targets in the Absecon Inlet Borrow Area, bringing the total number of high probability targets in this one borrow area to seven. Underwater ground truthing operations were conducted at 6 of these 7 target locations. One target was not investigated during ground truthing operations. Although site conditions in the inlet limited the ability of the divers to confirm the material responsible for generating each target, a re-analysis of previously collected and newly acquired remote sensing data suggests that 5 of the 7 targets located in the Absecon Borrow Area exhibit strong shipwreck characteristics. Historical research shows that one of these targets, although not confirmed in the field, is the probable location of the 85 foot barge "Troy", a modern vessel that sank in the inlet in the early 1980's.

No remote sensing targets were found in the Longport or the Offshore borrow areas.

4.11 HAZARDOUS, TOXIC, AND RADIOACTIVE WASTES (HTRW)

In accordance with ER 1165-2-132 entitled Hazardous, Toxic and Radioactive Wastes (HTRW) Guidance for Civil Works Projects, dated 26 June, 1992, the Corps of Engineers is required to conduct investigations to determine the existence, nature and extent of hazardous, toxic and radioactive wastes within a project impact area. Hazardous, toxic and radioactive wastes (HTRW) are defined as any "hazardous substance" regulated under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), 42 U.S.C. 9601 et seq, as amended. Hazardous substances regulated under CERCLA include "hazardous wastes" under Section 3001 of the Resource Conservation and Recovery Act (RCRA), 42 U.S.C. 6921 et seq; "hazardous substances" identified under Section 311 of the Clean Air Act, 33 U.S.C. 1321, "toxic pollutants" designated under Section 307 of the Clean Water Act, 33 U.S.C. 1317, "hazardous air pollutants" designated under Section 112 of the Clean Air Act, 42 U.S.C. 7412, and "imminently hazardous chemical substances or mixtures" that EPA has taken action on under Section 7 of the Toxic Substance Control Act, 15 U.S.C. 2606.

An HTRW literature search was conducted for Absecon Island by HRP Associates, Inc. for the U.S. Army Corps of Engineers Philadelphia District. The literature search identified 17 documented or potential HTRW sites in the project area, all located on Absecon Island (see Appendix A of the Main Report).

The preliminary assessment was divided into two sections. Both sections independently evaluated the impacts of the 17 potential HTRW sites identified. The first section discusses the impacts of the sites on potential offshore borrow areas. The second section evaluates the impacts of the sites on construction which requires excavation (for example, bulkhead replacements, outfall extensions and groin construction) that may take place on Absecon Island itself.

Three potential offshore borrow areas have been identified for Absecon Island. These three borrow areas are Absecon Inlet, a linear shoal offshore of Atlantic City, and the northern portion of Great Egg Harbor ebb shoal. A number of the documented HTRW can be eliminated from concern due to the fact that 1) there are hydraulic "disconnects" between the mainland and the borrow area (channels, inlets and general topography), and 2) there are no driving heads to propagate the spread of contamination. The conclusion that groundwater is not a vehicle for contaminant transport into the borrow areas can be drawn. As such, contaminant concerns for the above sites where groundwater is the main method of contaminant transport can be eliminated.

The borrow area in Absecon Inlet is proximal to 17 reported fuel spills in Clam Creek. The method for contaminant transport in this instance would be the tide and currents. The sediments in the borrow area are recent, and are continually reworked by the offshore environment. As such it is not believed that fuel spills in Clam Creek could have any significant impact on sediment quality in Absecon Inlet.

Lastly, the linear shoal offshore of Atlantic City is proximal to the reported location of the ordnance-explosive waste site (8). In 1961, and at this location, the U.S. Navy lost an undetermined amount of TNT charges in 27 feet of water. However, since the charges were not for underwater use and the borrow area does not intersect the area of concern shown on NOAA chart 12318, site 8 was eliminated from concern.

A number of potential HTRW sites were documented on Absecon Island. However, all of the sites except one were eliminated from concern for various reasons.

Some of the sites were eliminated due to the fact that they are beyond the project's limits. Other sites were eliminated due to the fact that the recommended plan in proximity to these sites will not include excavation, and as such the project would not

affect any HTRW . And lastly, 2 sites were eliminated due to the fact that they are located offshore, and as such will not be affected by landbased construction.

One site lies near the location of a proposed bulkhead on Absecon Inlet. Therefore, this site, which is curently a vacant lot with a leaking underground storage tank (LUST), was not eliminated from concern. However, excavation in this area would be minimal, especially excavation below the ground water table, which is the medium for contaminant transport in the area. For these reasons, this site would not be significantly impacted by a Corps of Engineers project nor will it significantly impact upon a Corps of Engineers project on Absecon Inlet. The complete HTRW analysis can be found in Appendix A of the Main Report.

4.12 SOCIO-ECONOMIC RESOURCES

Absecon Island is comprised of four communities; Atlantic City, Longport, Margate, and Ventnor, all of which are located within Atlantic County's 565 square miles. Atlantic County is the 6th least populated county within New Jersey, with a total population of 224,327 year round residents in 1990, equalling only 2.5% of the state's permanent population. Although Atlantic County covers 565 square miles, approximately three-quarters of the residents live within five miles of the ocean. Early development along these beach front communities is responsible for the currently slow growth trend within the study area's boundaries. Despite the slow growth rate, over 85% of seasonal residents in Atlantic County are concentrated in the island communities of Atlantic City, Brigantine, Longport, Margate, Ventnor and the backbay communities of Absecon, Linwood, Northfield and Sommers Point.

These communities rely heavily on the tourist industry for their economic stability. Although South Jersey is largely responsible for supporting the "Garden State" image, 62.9% of Atlantic County residents depend on service and sale oriented companies, while only 0.42% of the work force is employed in farming, fishing, or forestry.

Within the county, Atlantic City is the most heavily developed community with a population of 40,199 year-round residents in 1990, and 3,347.71 people per square mile, accounting for 2/3 of the study area's population. Between 1980 and 1990 however, Atlantic City experienced a decline of 5.6%, lowering the population to 37,986. The population is expected to continue to decline into the year 2000, when it will rise to approximately 40,450.

New development has slowed over recent years. In 1991 only one new privately owned housing unit was authorized by building permits in comparison to the 39 units authorized in 1990. This is largely due to the lack of vacant land, as only 6% of the total property was vacant by the year 1993. Unlike the majority of the study area, Atlantic City is heavily commercialized, composing 76.8% of the tax base, with only 14.28% residential. Atlantic City's beaches are primarily lined with commercial buildings such as hotels, casinos, and shops, while Longport, Margate, and Ventnor remain mostly residential.

The casinos have helped make the Atlantic City boardwalk famous, while helping to attract a total of 3.2 million visitors in 1993 alone. Not only have the casinos helped the city bring in needed tourist related jobs, but they have also helped to rebuild the neighboring communities by forming an organization called the Casino Reinvestment Development Authority (CRDA). In conjunction with the CRDA, Atlantic City has planned a $42 million housing rehabilitation program, which began construction in 1993. The program will provide 198 housing units on a 15 acre track of land in the Inlet section of Atlantic City.

To the south of Atlantic City is Ventnor, a resort city with a boardwalk and approximately 1.5 square miles of public beach, which nearly 28,000 summer residents came to enjoy in 1993. Ventnor's population has also declined over the past decade by approximately 6%, to 11,005 in 1990. It is projected that the population will continue to decline by 5% until the year 2000, to a total of 10,418.

Because of the town's proximity to Atlantic City, Ventnor is also very highly developed, with a total of 5,135 residents per square mile. In 1991 there were only three building permits issued for single family units, compared to 27 permits authorized in 1989. The community is primarily residential, with only 2 industrial complexes and 141 commercial lots within the city's boundaries.

Bordering Ventnor to the south is Margate. Unlike Ventnor and Atlantic City, Margate is more of a residential community. Margate encompasses 1.41 square miles of land. Neither Margate nor Longport own boardwalks, however all of their beaches allow public access. The beach front is almost solely residential, with only a few commercial and public buildings.

Like all of the cities in the study area, Margate has primarily a service oriented labor force. Out of 4,563 civilian employees, 53% are service oriented with only 0.15% in the farming, fishing and forestry industry.

The last town in the study area is Longport, which lies between Margate and Great Egg Harbor Inlet. Longport is a small, quiet, residential community with older residents. The median age is 58.4, years and more than half of the residents are retired. There are no boardwalks or amusement parks to attract the younger crowd, however there are approximately 1.24 square miles of public access beaches, which bring in nearly 6,000 summer residents and 1,224 year round residents.

5.0 ENVIRONMENTAL CONSEQUENCES

5.1 COMPARATIVE EFFECTS OF ALTERNATIVES

The no action alternative will allow continuation of existing conditions, as well as the existing processes which currently modify those conditions. Consequently, the following discussion will focus on the impacts of the beach nourishment and bulkhead alternative, with impacts associated with the no action alternative discussed when appropriate.

5.2 TOPOGRAPHY AND SOILS

Under the no action alternative, erosion would continue and more beach would be lost. Without further engineering efforts, the existing bulkheads and erosion control measures would be rendered ineffective or breached as the beach profile becomes steeper and the wave energy becomes harsher.

The beach nourishment alternative would result in topography changes in the proposed Absecon Inlet borrow area. The dredging would increase the depth by approximately 12 to 15 feet in the borrow area. Based on the quantities of material required, all 345 acres of the borrow area will probably need to be utilized. The resulting cross-sectional configuration would be designed to approximate natural ridge slopes, and therefore promote free exchange of water with the overlying and adjacent waters. The excavation would also be designed to ensure that all of the bottom substrate would not be removed, and therefore the bottom would retain its existing substrate character. In addition, due to the dynamic location of the borrow area within the Inlet, it is anticipated that the sand source will be replenished fairly quickly. The intent of excavating a broad basin with depth, contours, and substrate consistent with the adjacent areas was to simulate the character of these nearby environments. It is not anticipated that the proposed excavation of material should adversely affect sand and gravel production.

Regarding the beach, the berm restoration would result in a berm 100 feet wide in Ventnor, Margate, and Longport, and 200 feet wide in Atlantic City. All areas would have a final berm elevation of +8.5 feet NGVD. A dune with a top elevation of +14 feet NGVD and a top width of 25 feet will be constructed in Ventnor, Margate, and Longport, while in Atlantic City the top elevation will be +16 feet NGVD. The grade of the foreshore and underwater slopes would essentially parallel the existing profile. The increase in beach elevation would effectively widen the beach. The net result would be a larger buffer against the erosion from storm events, and also an increase in usable beach in the project area.

Results from coastwide acoustic subbottom profiling and vibrocores indicate that three potential borrow areas exist for the Absecon Island area. Detailed information on these borrow areas can be found in section 3.5.1 of the FEIS and Borrow Area Selection section of the main report.

5.3 WATER QUALITY

The dredging associated with the beach nourishment alternative would result in short-term adverse impacts to water quality in the immediate vicinity of the dredging and beach nourishment operations. Dredging in the proposed borrow area will generate turbidity, resulting in sedimentation impacts within the immediate vicinity of the operations. Short-term increased turbidity can effect organisms in several ways. Primary production in phytoplankton and/or benthic algae may become inhibited from turbidity. Suspended particulate matter can clog gills and inhibit filter-feeding species. Reilly et.al. 1983 determined that high turbidity could inhibit recruitment by pelagic larval stocks. In addition, midwater nekton like finfish and mobile benthic invertebrates may migrate outside of the area where turbidity and deposition occur.

The amount of turbidity and its associated plume is mainly dependent on the grain size of the material. Generally, the larger the grain-size, the smaller the area of impact. The period of turbidity is also less with larger grain-sized materials. The proposed borrow location contains medium to fine sands, which are coarser grained than silts and clays. Turbidity resulting from the resuspension of these sediments is expected to be localized and temporary in nature. Utilization of a hydraulic dredge with a pipeline delivery system will help minimize the impact, however, some disturbance will occur.

Similar effects to water quality on aquatic organisms could likely be incurred from the deposition of borrow material on the beach. Increased turbidity resulting from the deposition of a slurry of sand will be temporary in nature and localized. This effect will not be significant as turbidity levels are naturally high in the high-energy surf zone. Organisms in the surf zone versus deep water areas will be less likely to suffer adverse effects from turbidity because they have already adapted to these conditions. Fine sediments sifted from the deposited material would be transported by waves and currents into the nearshore with varying environmental impacts from a few months to at least seven years (Hurme and Pullen, 1988). Parr et al, 1978 determined that fine materials were rapidly sorted out and transported offshore after beach deposition. In their study, the dredged material had a much higher silt content than the beach, however, all of the silt was removed within 5 months. The selection of borrow material from a high energy environment should minimize the fine particle content. Material taken from the proposed Absecon Island borrow area will have low quantities of silt, therefore, high levels of turbid waters after deposition should not persist.

The borrow material is not expected to be chemically contaminated. The use of beach nourishment quality sand from a high energy environment coupled with the absence of nearby dumping activities, industrial outfalls, or contaminated water infers the low probability that the borrow material would be contaminated by pollutants.

5.4 TERRESTRIAL ECOLOGY

5.4.1 Effects on Flora and Fauna of Upper Beach

Construction of the beach nourishment alternative would result in the initial placement of approximately 6.2 million cubic yards of sand on the beach, with subsequent periodic nourishments of approximately 1,666,000 cubic yards every 3 years for a project life of 50 years. This construction will greatly disturb the impacted beach area, however, impacts to terrestrial species are expected to be minor and temporary. The existing species inhabiting the beach are generally capable of surviving adverse conditions, and most are capable of migrating out of the impacted area. Therefore, impacts are not expected to be significant. It would be reasonable to expect recolonization from adjacent areas shortly after the end of construction, and a rapid return to pre-construction conditions.

5.5 AQUATIC ECOLOGY

5.5.1 Effects of Beachfill Placement on Benthos

The majority of the impacts of beachfill placement will be felt on organisms in the intertidal zone and nearshore zones. The nearshore and intertidal zone is highly dynamic, harsh, and is characterized by great variations in various abiotic factors. Fauna of the intertidal zone is highly mobile and responds to stress by displaying large diurnal, tidal, and seasonal fluctuations in population density (Reilly et al. 1983). Despite the resiliency of intertidal benthic fauna, the initial effect of beachfill deposition will be the smothering and mortality of existing benthic organisms within the shallow nearshore (littoral) zone. This will initially reduce species diversity and number of animals. Burial of less mobile species such as amphipods and polychaete worms would result in losses, however, densities and biomasses of these organisms are relatively low on beaches. Beach nourishment may also inhibit the return of adult intertidal organisms from their nearshore-offshore overwintering refuges, cause reductions in organism densities on adjacent unnourished beaches, and inhibit pelagic larval recruitment efforts. Parr et al.1978 notes that the nearshore community is highly resilient to this type of disturbance, however, the offshore community is more susceptible to damage by receiving high sediment loads from fines sorting-out from a beachfill. The ability of a nourished area to recover depends heavily on the grain size compatibilities of material pumped on the beach (Parr et al.,1978). Reilly et al. 1978 concludes that nourishment initially destroys existing macrofauna, however, recovery is usually rapid after pumping operation ceases. Recovery of the macrofaunal component may occur within one or two seasons if grain sizes are compatible with the natural beach sediments. However, the benthic community may be somewhat different from the original community. Hurme et. al. 1988 caution, "Macrofauna recover quickly because of short life cycles, high reproductive potential, and planktonic recruitment from unaffected areas. However, the recolonization community may differ considerably from the original community. Recolonization depends on the availability of larvae, suitable conditions for settlement, and mortality. Once established, it may be difficult for the original community species to displace the new colonizers." Benthic recovery on the beach/intertidal zone may become hampered by the three-year periodic nourishments. Based on the above mentioned studies, the benthic community may take 1-2 years to recover. With a three-year renourishment cycle, the benthic community may be in a higher than normal state of flux due to periodic disturbances from re-nourishment. It is conceivable that the benthic community may attain a recovered state for a period of 1-2 years before being disturbed again by a re-nourishment cycle.

Geomorphological studies on the sediments within the proposed borrow sites indicate that there will be relatively low levels of fine sediments placed on the Absecon Island beach. Parr et.al. 1978 recommend that to minimize biological impacts, the percentage of fine sediments (smaller than 125 micrometers) should be low to minimize siltation and consequent deposition offshore, which may create anoxic conditions in the sediment. The berm restoration would be conducted in a manner that approximates the existing beach profile. The approximate area of intertidal and shallow nearshore habitat lost resulting from the beachfill would be likewise created seaward. Therefore, no signigicant loss of intertidal or shallow nearshore habitat is expected.

5.5.2 Effects on Benthos at Borrow Sites

The primary ecological impact of dredging the sand borrow sites will be the complete removal of the existing benthic community through entrainment into the dredge. It is estimated that approximately 345 acres of benthic habitat will be impacted by dredging during the project. Dredging will primarily impact the benthic and epibenthic organisms. Mortality of these organisms will occur as they pass through the dredge device and/or as a result of being transplanted into an unsuitable habitat. A secondary disturbance would be the generation of turbidity and deposition of sediments on the benthic community adjacent to the dredging. Despite the initial effects of dredging on the benthic community, recolonization is anticipated to occur within one year. Saloman et al. 1982 determined that short-term effects of dredging lasted about one year resulting in minor sedimentological changes, and a small decline in diversity and abundance within the benthic community. The recovery of a borrow area is dependent upon abiotic factors such as the depth of the borrow pits, and the rate of sedimentation in the borrow pits following the dredging. Dredging a borrow pit can result in changes that affect circulation patterns resulting in pits where fine sediments can become deposited, which may lead to hypoxia or anoxia in the pit. Accumulations of fine sediment may also shift a benthic community from predominantly a filter-feeding community to a deposit-feeding community. It is important that for recovery, the bottom sediments are composed of the same grain sizes as the pre-dredge bottom. Cutler et al. (1982) investigated long-term effects of dredging on the benthic community and noted that faunal composition was different than the pre-dredge community, however, the difference was attributed more to normal seasonal and spatial variations. In this study, it was determined that there were no significant differences in the benthic communities and sediment parameters between borrow sites and surrounding areas. Periodic disturbances from maintenance of the project may favor the development of benthic communities composed primarily of colonizers. Assuming that the same location is dredged every three years, the secondary benthic community may be in a higher state of flux than the original community. This may, in effect, favor more r-selected (rapid reproduction, short life span) benthic species in the sand borrow impact area over the 50-year project life. In addition, benthic organism abundances may be lower than normal. However, this may not be the case if subsequent dredging cycles are conducted at different locations within the borrow area. This would allow disturbed areas from previous dredging disturbances to become recolonized.

Benthic investigations in and around the selected borrow sites reveal benthic communities that range between low and high infaunal abundance with low species diversity. Recolonization of the benthic community may occur within 1-2 years following dredging, however, the effects of the three year periodic project maintenance over a 50 year project life may have more profound adverse effects if conducted at the same locations. Hurme et al. (1988) recommend that borrow materials be obtained from broad, shallow pits in nearshore waters with actively shifting bottoms, which would allow for a sufficient surficial layer of similar sediments for recolonization. Measures that would minimize the effects of dredging in the borrow area include dredging in a manner as to avoid the creation of deep pits, alternating locations of periodic dredging, dredging during lowest biological activity, and the utilization of a hydraulic dredge with a pipeline delivery system to help minimize turbidity.

5.5.3 Effects of Groin Burial on Marine Biota

Groins, which represent artificial rocky intertidal habitat, will be subject to sand burial from beach nourishment. The landward ends of some of the groins would be permanently covered with sand. Once covered, the landward ends of the groins would not be available for fishermen to use nor to provide habitat for invertebrates, finfish, and shorebirds. Non-mobile organisms and intertidal dwellers would be affected by burial from the placement of sand. The fill placement over the groins is expected to re-establish sandy bottomed intertidal habitat.

5.5.4 Impacts on Fisheries

5.5.4.1 Shellfish

Sampling conducted by Versar, Inc. in October 1995 documented the current population of surf clams within the 3 proposed borrow areas. The borrow area proposed for the initial beachfill and nourishment cycles, Absecon Inlet borrow area, contains the lowest densities of surf clams. It is anticipated however, that the surf clams within this borrow area will be removed during dredging activities. Mortality of the clams will occur as they pass through the dredge device and/or as a result of being transplanted into an unsuitable habitat. A secondary disturbance would be the generation of turbidity.

In order to minimize impacts to surf clams within the project area, dredging activities will primarily take place within the Absecon Inlet borrow area for the initial construction, as well as the subsequent nourishment cycles. If, due to available sand quantities, it becomes necessary to utilize one of the other borrow areas for subsequent nourishment cycles, updated surveys will be done to determine current populations. Measures will be taken in Absecon Inlet, as well as the other borrow areas if necessary, to minimize impacts to the clams. Some of these measures may include the commercial harvest of clams prior to dredging and only disturbing a portion of the site. All measures will be fully coordinated with the appropriate Federal, state, and local agencies.

5.5.4.2 Finfish

With the exception of some small finfish, most bottom and pelagic fishes are highly mobile, and should be capable of avoiding entrainment into the dredging intake stream. It is anticipated that some finfish would avoid the turbidity plume while others may become attracted to the suspension of food materials in the water column. Little impact to fish eggs and larvae are expected because these life stages are widespread throughout the Middle Atlantic Bight, and not particularly concentrated in the borrow site or surf zone of the project area (Grosslein and Azarovitz, 1982).

The primary impact to fisheries will be felt from the disturbance of benthic and epibenthic communities. The loss of benthos and epibenthos entrained or smothered during the project will temporarily disrupt the food chain in the impact area. This effect is expected to be temporary as these areas become rapidly recolonized by pioneering benthic and epibenthic species.

5.6 THREATENED AND ENDANGERED SPECIES

The piping plover, which is State and Federally listed as threatened, is a frequent inhabitant of New Jersey's sandy beaches. Past nesting sites of this species in New Jersey have included the southern end of Brigantine, Ocean City, and several locations in Cape May. No known nesting sites have been identified within the study area on Absecon Island. Based on the high development and human disturbance, it is unlikely for piping plovers to nest within the project area. However, if a piping plover nest is discovered within the project area prior to the commencement of the initial beach nourishment and periodic maintenance activities, the Corps will contact the New Jersey Department of Environmental Protection, Division of Fish, Game and Wildlife and the U.S. Fish and Wildlife Service to determine appropriate measures to protect the piping plovers from being disturbed. These measures may include establishing a buffer zone around the nest, and limiting construction to be conducted outside of the nesting period (1 April - 15 August).

From June through November, New Jersey's coastal waters may be inhabited by transient sea turtles, especially the loggerhead (Federally listed threatened) or the Kemp's ridley (Federally listed endangered). Sea turtles have been known to be adversely impacted during hopper dredging operations. Dredging encounters with sea turtles have been more prevalent along waters of the southern Atlantic and Gulf coasts, however, incidences of "taking" sea turtles have been increasing in waters of the middle Atlantic coast. Coordination with the National Marine Fisheries

Service (NMFS) in accordance with Section 7 of the Endangered Species Act has been undertaken on all Philadelphia District Corps of Engineers dredging projects that may have impacts to Federally threatened or endangered marine species. A Biological Assessment that discusses Philadelphia District hopper dredging activities and potential effects on Federally threatened or endangered species of sea turtles has been prepared, and was formally submitted to the NMFS in accordance with Section 7 of the Endangered Species Act. It is anticipated that the NMFS will issue a Biological Opinion prior to preparation of the Final Environmental Impact Statement. Adherence to the findings of the Biological Opinion will insure compliance with Section 7 of the Endangered Species Act. In the interim, measures to reduce the likelihood of disturbing or taking of these species would be implemented through coordination with the NMFS. Recent projects that have utilized a hopper dredge between June and November have been required to place NMFS approved sea turtle observers on the dredge to monitor for sea turtles during dredging. Observers inspect the hopper, skimmer, and draghead after each load looking for signs of interaction with endangered or threatened species. Other measures that have been taken to reduce the impact to sea turtles include the use of rigid dragarm deflectors and pre-dredging trawling.

5.7 IMPACTS ON CULTURAL RESOURCES

5.7.1 Project Impact Areas for Cultural Resource Review

Proposed project construction has the potential to impact cultural resources in four areas. These are the existing beach and near-shore sand placement areas, inlet frontage, and offshore borrow areas. In the beach and near-shore sand placement areas, potential impacts to cultural resources could be associated with the placement and compaction of sand during berm and dune construction. Impacts in the inlet frontage area could occur during bulkhead and revetment construction. Dredging activities in offshore borrow areas could impact submerged historic properties.

5.7.2 Shoreline and Near-shore Sand Placement Areas

On the basis of the current project plan, the Corps is of the opinion that sand placement within shoreline and near-shore project areas will have no effect on significant cultural resources. These areas are located in a highly unstable and shifting coastal environment, where the likelihood for intact and undisturbed cultural resources is considered extremely minimal. No archaeological sites were identified during documentary and pedestrian shoreline surveys (Cox and Hunter, 1995). The shoreline survey did identify two historic entertainment piers that are potentially eligible for listing in the National

Register of Historic Places - the Steeplechase Pier and the Garden Pier. Sand placement will have no effect on these two properties. A remote sensing survey was not conducted in the near-shore project area due to unsafe conditions in a very high energy, tidal surf zone. Properties in the Absecon Island area currently listed on the National Register of Historic Places are located outside of the project area.

5.7.3 Inlet Frontage Area

The proposed plan includes the construction of a timber sheet-pile bulkhead and quarry stone revetment along the south side on Absecon Inlet. Bulkhead construction will follow a previously disturbed older bulkhead alignment adjacent to Maine Avenue. A quarry stone revetment will be built next to the new bulkhead and will extend out into the inlet in an area that has been previously modified and dredged on numerous occasions. For these reasons, a cultural resources pedestrian and remote sensing survey was not conducted in these project areas. Alterations to the natural topography is severe. The District anticipates that no significant cultural resources will be affected in these project locations.

5.7.4 Offshore Borrow Areas

Remote sensing investigations were conducted in project borrow areas (Cox and Hunter 1995). No targets resembling potential shipwrecks were recorded in the Offshore and Longport borrow areas. Sand dredging will have no effect on significant cultural resources in these project locations. Seven underwater targets were identified in the Absecon Inlet Borrow Area. Underwater ground-truthing and re-analysis of previously recorded and newly acquired remote sensing data suggests that five of these targets are potentially significant shipwreck sites (Cox 1995). Proposed sand borrowing activities will adversely impact three of these target locations, which may represent significant cultural resources. Therefore, in order to eliminate construction impacts at these locations, the Philadelphia District proposes to completely avoid these three remote sensing targets during sand borrowing operations by delineating at least a 200 foot buffer around each target.

5.7.5 Section 106 Coordination

The draft report of the remote sensing investigation, entitled "A Phase 1 Submerged and Shoreline Cultural Resources Investigation, Absecon Island, Atlantic County, New Jersey (Cox and Hunter 1995) and an executive summary entitled "A Phase 1 and 2 Submerged and Shoreline Cultural Resources Investigation, Brigantine Inlet to Hereford Inlet, Atlantic and Cape May Counties, New Jersey" (Cox 1995) was submitted to the New Jersey State Historic Preservation Office (NJSHPO) for Section 106 review and comment on December 4, 1995 (see Pertinent Correspondence Appendix). The Philadelphia District does not anticipate any impacts on significant cultural resources resulting from berm, dune, bulkhead and revetment construction along shoreline and inlet areas as proposed in the feasibility study. Potentially significant submerged sites identified in the Absecon Inlet Borrow Area will be avoided by a 200 foot buffer around each target and will not be impacted by proposed dredging. The NJSHPO concurred with the District's finding of "No Effect" in a letter dated January 19, 1996 (see Pertinent Correspondence Appendix).

5.8 IMPACTS ON NOISE AND AIR QUALITY

Minor short-term impacts to air quality and noise levels would result from the construction phases of the beach nourishment alternative. Dredging activities and grading equipment use would produce noise levels in the 70 to 90 dBA (50 feet from the source) range, but these would be restricted to the beach area. These noises would be masked by the high background levels of the surf or dissipated by distance. Ambient air quality would also be temporarily degraded, but emission controls and limited duration aid in minimizing the effects. In the case of equipment use associated with the periodic nourishment efforts, conducting the work in the off-season would further minimize the impact.

Noise and air quality impacts would be restricted to site construction preparation (generally beginning two weeks prior to dredging) and the actual dredging and placement operation. Noise is limited to the utilization of heavy equipment such as bulldozers to manipulate the material during placement. Additional noise may be caused by a pumpout station, if necessary. Depending on future circumstances, the construction may be conducted overnight to meet construction schedules. Air quality impacts would similarly be limited to emissions from the heavy equipment and pumpout station (if used). No long-term significant impacts to the local air quality are anticipated.

Air quality impacts would similarly be limited to emissions from the heavy equipment used during construction. Pollutant emissions discharged from heavy equipment such as dredges and dozers are regulated by the EPA on the engine manufacturers. Since dredging operations would be conducted in a "moderate" non-attainment area for ozone, equipment operations would not have any long-term adverse effects on the attainment criteria in Atlantic County. The Environmental Protection Agency Region II had reviewed the Draft EIS, and had no adverse comments relative to air quality impacts pursuant to Section 309 of the Clean Air Act. A statement of conformity with the State Implementation Plan is provided in Section 9.0 of this FEIS.

5.9 IMPACTS ON SOCIO-ECONOMICS

The no action alternative would allow the beach to continue to erode, and this would increase the risk of damage to private property from flooding or direct wave action as the protective beach decreased in size. Property values would also fall as this risk became more and more perceived by the market. Recreational opportunities would also decrease with the size of the beach. This would be translated into lost tourism revenue which would have a secondary effect on employment.

New Jersey beaches and casinos are consistently one of the main travel destinations in New Jersey, and account for a large portion of the State's visitations and revenue. It is expected that local and State efforts to attract visitation and expand their associated facilities will continue. The New Jersey beaches and casinos play an extremely significant role in the well being of New Jersey's tourism industry, and in New Jersey's overall economy.

Under the beach nourishment alternative, the beach berm created by the placement of suitable material and periodic nourishment would permit the accommodation of both present and expected future demands for recreational beach area along Absecon Island. This influx of seasonal population is reflected by a greater demand for social services such as housing, transportation, health, safety, and sanitation facilities. As the demand for recreation gradually increases, it is expected that State and local efforts would be made to satisfy these needs. Because of this, noise and air quality levels would similarly degrade through personal activity and auto utilization. They will not however, become a significant problem.

Various indicators of the presence and/or level of Corps activity in beachfront communities generally have no statistically significant relation to development in those areas. Thus, the statistical evidence indicates that the effect of the Corps on induced development is, at most, insignificant, compared to the general forces of economic growth which are stimulating development in these areas, many of which are induced through other municipal infrastructure developments such as roads, wastewater treatment facilities, etc. (U.S. Army Corps of Engineers, 1995).

5.10 RECREATION

The proposed project as a secondary benefit, may improve opportunities for recreational beach use. Recreational shore and surf fishing will be temporarily affected by the project, since the public and fishermen will not be permitted to enter the actual work segments. However, since the project will be constructed in sections, only those sections actually under construction will be closed to the public. Impacts to shore and surf fishing access will be localized and relatively short-lived. A minor impact on recreational fishing will result from covering the existing groins with sand.

5.11 AESTHETICS

Beach nourishment is a more natural and soft structural solution to reducing storm damages on Absecon Island. With the exception of short-term impacts during construction, overall aesthetics of the beach would be improved as a result. A natural-looking beach and dune would be more aesthetically pleasing and attractive to residents and tourists. However, despite the visual benefits the beach nourishment alternative would provide, a restored dune may inhibit ocean views in some project impact areas.

The boardwalk elevations on Absecon Island range from 10.5 to 15 feet NGVD. At the lower elevations, views of the ocean may be impacted. However, of the 3.4 miles of boardwalk in Atlantic City, only seven percent is below 11 feet NGVD. Therefore, in these areas, the possibility exists for some aesthetic impacts in terms of the accessability of wave and ocean views. Currently there are some areas within Absecon Island that have limited views of the ocean. This is due to the fact that dune repairs/restoration have been made in some areas which have increased the height of the dunes. This, combined with the narrow width of the beach, leaves the waves breaking close to the toe of the dunes and hampering the visual aesthetics. If the dunes for the proposed project were built on the current beach, aesthetic impacts would also exist due to the fact that currently the waves break very close to the toe of the dune in many areas of the project. Once the proposed beachfill is in place however, the area where the waves break will be much further from shore, therefore making the waves easier to see from the boardwalk, and minimizing negative aesthetic impacts.

5.12 UNAVIODABLE ADVERSE IMPACTS

The long-term adverse impact of the no action alternative would not be to the natural environment but to the regional economic environment. Tourism and utilization would decrease as beach loss continues. As the risk of storm damage increases, property values would decrease. Actual storm damage and higher insurance premiums would erode business profits.

The long-term adverse impact of the beach nourishment alternative would be the decreased benthic community standing stocks, which would be affected during each dredging operation.

5.13 SHORT-TERM USES OF THE ENVIRONMENT AND LONG-TERM PRODUCTIVITY

The no action alternative does not involve short-term uses but would affect the long-term economy of the project area as indicated in Section 5.9. On the other hand, the beach nourishment alternative would enhance the economy by storm damage reduction as well as by providing additional recreational area.

5.14 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

The no action alternative does not involve a commitment of resources. The beach nourishment alternative would involve the utilization of time and fossil fuels which are irreversible and irretrievable. Impacts to the benthic community would not be irreversible as benthic communities would redevelop with cessation of all dredging activity.

5.15 CUMULATIVE EFFECTS

Cumulative Impact as defined in CEQ regulations is the "impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time."

Projects of this nature using beach nourishment from offshore borrow sites are becoming increasingly common in coastal areas as areas of high development become susceptible to the erosive forces present. Numerous beach nourishment projects have been conducted along the Atlantic Coast since the 1950's by local, state and Federal agencies, as well as private interests. Depending on circumstances such as the methods being utilized to alleviate the coastal erosion and ensuing storm damages and the existing ecological and socio-economic conditions, it is difficult to gauge the net cumulative effects of these actions. The scientific literature generally supports that beach nourishment projects, if planned properly, have short-term and minor ecological effects, however, we are not aware of any studies that consider regional or national cumulative impacts of these projects on resources of concern. It is our position that since this project was designed to minimize adverse environmental effects of all types, this project should not culminate in adverse cumulative impacts on ecological and socio-economic resources, or if it does, to the minimum extent possible.

5.16 MITIGATION MEASURES

Mitigation measures are utilized to minimize or mitigate for project impacts to environmental resources within the project area. The appropriate application of mitigation is to formulate a project that avoids or minimizes adverse impacts first, and compensates for impacts only as a final alternative. Several measures can be adopted to avoid or minimize project impacts on effected resources such as: benthic resources, fisheries, endangered species, cultural resources, recreation, and noise.

Mitigation measures are either institutional in that environmental mitigation is inherent in project alternative selection, or as measures incorporated into the construction and operation and maintenance of the project. Several institutional measures have already been adopted to minimize the impacts on these resources. These measures include the selection of the beach nourishment alternative. This alternative offers a more naturalistic and softer approach for storm damage reduction. Selection of this alternative is based on its relatively low ecological impacts and its cost effectiveness. Another institutional measure is the utilization of offshore sand borrow areas. These areas are characterized by high energy and shifting sands resulting in a benthic community of lower abundance and diversity as compared to more stable benthic environments. Therefore, biological impacts are expected to be lower. Another measure is the selected use of suitable sand grain sizes for beach nourishment. The selection of borrow areas is based on compatibility studies for sand grain sizes. The selection of coarser beach nourishment quality material will minimize impacts on water quality at the dredging site and discharge (placement) site.

As discussed in the preceding paragraphs, the beach nourishment alternative does contain unavoidable impacts to several environmental resources of concern. These impacts can be minimized by implementing several measures during construction, and operation and maintenance of the project. Mitigation measures recommended for construction, and operation and maintenance of the project involve minimizing impacts to: benthic resources, fisheries, endangered species, recreation, noise and cultural resources. The following measures are recommended, however, their implementation is dependent upon the circumstances that may be encountered at the time of project construction or periodic maintenance.

5.16.1 Benthic Resources

The majority of unavoidable impacts are likely to be incurred on the benthic communities within the project area. Measures to minimize the effects of dredging in the borrow area will include dredging in a manner as to avoid the creation of deep pits, using only Absecon Inlet borrow area for the initial construction, using primarily Absecon Inlet for nourishment cycles as long as possible, alternating locations of periodic dredging, conducting dredging during months of lowest biological activity (when possible), and the utilization of a pipeline delivery system to help minimize turbidity. Implementation of a benthic monitoring program concurrent with periodic maintenance activities would document project impacts and aid in avoiding impacts to sensitive areas during the periodic maintenance activities.

5.16.2 Fisheries

Adverse impacts to the surf clam population may be minimized by trying to use only one borrow area (Absecon Inlet) for the initial beachfill and subsequent nourishment for as long as possible. This borrow area had the lowest numbers of surf clams and due to its location is not easily accessable to commercial clamming dredges. If it becomes necessary to utilize one of the other borrow areas for subsequent nourishment cycles, updated surveys will be done to determine current populations. If viable populations still exist within the proposed borrow areas, measures will be taken in order to minimize impacts to the clams. Some of these measures may include the commercial harvest of clams prior to dredging and only disturbing a portion of the site. All measures will be fully coordinated with the appropriate Federal, state, and local agencies.

5.16.3 Threatened and Endangered Species

Based on coordination with appropriate resource agencies and the high development in the project impact site, it is unlikely for piping plovers to nest within the project area. However, if a piping plover nest is discovered within the project area prior to the commencement of the initial beach nourishment and periodic maintenance activities, the Corps will contact the New Jersey Department of Environmental Protection, Division of Fish, Game and Wildlife and the U.S. Fish and Wildlife Service to determine appropriate measures to protect the piping plovers from being disturbed. These measures may include establishing a buffer zone around the nest, and limiting construction in these areas to periods outside of the nesting season (1 April - 15 August).

Depending on the timing of the dredging and the type of dredge to be used, it may be necessary to implement mitigative measures to avoid adversely impacting threatened or endangered sea turtles. Measures to avoid or minimize impacts to these species may include but not be limited to utilizing NMFS approved turtle monitors, utilizing specially modified hopper dredges, and use of trawlers that can intercept and transport turtles away from the dredging impact area. It may not be necessary to implement these measures if dredging is conducted within the winter months when turtle activity is lowest in this area. These measures would be implemented based on the findings of the forthcoming Biological Opinion to be issued by NMFS.

5.16.4 Recreation

Beachfill operations typically occur within isolated segments, subsequently moving as the work progresses. As each work segment is completed, it can be opened for recreational use. This would allow access for recreation in all areas outside of the segment under construction.

5.16.5 Air Quality and Noise

Air quality and noise impacts can be reduced by utilizing heavy machinery fitted with approved muffling apparatus that reduces noise, vibration, and emissions.

5.16.6 Cultural Resources

The identification of five small magnetic targets within the proposed Absecon Inlet sand borrow area exhibiting shipwreck characteristics will be avoided during project construction. This will be accomplished by delineating at least a 200 foot buffer around each target.

6.0 LIST OF PREPARERS

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6.2 Studies Conducted for or Reported in this Draft Environmental Impact Statement

6.2.1 Benthic Evaluation

"Brigantine Inlet to Great Egg Harbor Inlet Feasibility Study, Atlantic County, New Jersey: Benthic Animal Assessment of Potential Borrow Source" (Battelle Ocean Sciences, 1995) in Appendix A.

"Evaluation of Benthic Macrofaunal Resources at Potential Sand Borrow Sources: Brigantine Inlet to Great Egg Harbor Inlet, Atlantic County, New Jersey" Versar, Inc, 1996)

6.2.2 Cultural Resources

"A Phase 1 Submerged and Shoreline Cultural Resources Investigation, Absecon Island, Atlantic County, New Jersey (Draft)". (Hunter Research, 1995) in Appendix A.

"A Phase 1 and 2 Submerged and Shoreline Resources Investigation, Brigantine Inlet to Hereford Inlet, Atlantic and Cape May Counties, New Jersey (Executive Summary)". (Hunter Research, 1995) in Appendix A.

7.0 PUBLIC INVOLVEMENT

Coordination for this project was done with Federal, State and local resource agencies. Agencies notified of this study included the U.S. Fish and Wildlife Service (USFWS), U.S. Environmental Protection Agency (USEPA), National Marine Fisheries Service (NMFS), New Jersey Department of Environmental Protection (NJDEP), and New Jersey State Historic Preservation Office. Information in this document was generated based on comments and concerns of the interested public.

Two Planning Aid Reports prepared by the USFWS are provided in Appendix C of the main report. An official section 2(b) Fish and Wildlife Coordination Act Report was prepared by the USFWS after public circulation of the Draft Environmental Impact Statement and is provided in the comment/response section. This report provides official USFWS comments on the project pursuant to the Fish and Wildlife Coordination Act. Comments received from Federal, State, and local government agencies along with various private organizations and individuals on the DEIS are presented in the comment/response appendix of this report.

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8.0 EVALUATION OF 404(b)(1) GUIDELINES

I. PROJECT DESCRIPTION

A. Location

The proposed project site includes the communities of Margate, Longport, Atlantic City, and Ventnor, on Absecon Island, Atlantic County, New Jersey. In addition to these communities, the specific areas involved are the three borrow areas found in Absecon Inlet, offshore of Absecon Inlet, and in Great Egg Harbor Inlet.

B. General Description

The proposed project involves reducing potential storm damages along Absecon Island, New Jersey by placement of dredged material (sand) from the Absecon Inlet borrow area on the beachfront in the form of a berm 200 feet wide with a top elevation of +8.5 feet NGVD29 in Atlantic City, and a 100 foot wide berm with a top elevation of +8.5 feet NGVD29 in Ventnor, Margate, and Longport. In Margate, Ventnor, and Longport, dunes will also be constructed to a top elevation of +14 feet NGVD29, with a 25 foot top width, and side slopes of 1V:5H. The Atlantic City dune will have a top elevation of +16 feet NGVD29, top width of 25 feet, and side slopes of 1V:1H. The dunes are proposed to be planted with 91 acres of dune grass. The dunes will also contain 63,675 linear feet of sand fence, as well as pedestrian and vehicular access ramps.

The proposed project also includes the construction of two timber sheet-pile bulkheads along the Absecon Inlet frontage. The bulkheads would tie into the existing bulkhead along Maine Avenue. The bulkheads would be constructed to a top elevation of +14 feet NGVD29, with pile anchors and tie-backs. A revetment of 3-5 ton rough quarrystone will be constructed to an elevation of +5 feet NGVD29 on the seaward side of the bulkhead.

C. Authority and Purpose

The authority for the proposed project is the resolution of the Committee on Public Works and Transportation of the United States House of Representatives, and the Committee on Environment and Public Words of the United States Senate, dated December 1987.

The Senate resolution adopted by the Committee on Environment and Pubic Works on December 17, 1987 states:

"That the Board of Engineers for Rivers and Harbors, created under Section 3 of the Rivers and Harbors Act, approved June 13, 1902, be, and is hearby requested to review existing reports of the Chief of Engineers for the entire coast of New Jersey with a view to study, in cooperation with the State of New Jersey, its political subdivisions and agencies and instrumentalities thereof, the changing coastal processes along the coast of New Jersey. Included in this study will be the development of a physical, environmental, and engineering database on coastal area changes and processes, including appropriate monitoring, as the basis for actions and programs to prevent the harmful effects of shoreline erosion and storm damage; and, in cooperation with the Environmental Protection Agency and other Federal agencies as appropriate, develop recommendations for actions and solutions needed to preclude further water quality degradation and coastal pollution from existing and anticipated uses of coastal waters affecting the New Jersey Coast. Site specific studies for beach erosion control, hurricane protection, and related purposes should be undertaken in areas identified as having potential for a Federal project, action, or response".

The House resolution adopted by the Committee on Public Works and Transportation on December 10, 1987 states:

> "That the Board of Engineers for Rivers and Harbors is hearby requested to review existing reports for the Chief of Engineers for the entire coast of New Jersey with a view to study, in cooperation with the State of New Jersey, its political subdivisions and agencies and instrumentalities thereof, the changing coastal processes along the coast of New Jersey. Included in this study will be the development of physical, environmental, and engineering database on coastal area changes and processes, including appropriate monitoring, as the basis for actions and programs to prevent the harmful effects of shoreline erosion and storm damage; and, in cooperation with the Environmental Protection Agency and other Federal agencies as appropriate, the development of recommendations for actions and solutions needed to preclude further water quality degradation and coastal pollution from existing and anticipated uses of coastal waters affecting the New Jersey Coast. Site specific studies for beach erosion control, hurricane protection, and related purposes should be undertaken in areas identified as having potential for a Federal project, action, or response which is engineeringly, economically, and environmentally feasible".

The purpose of the project is to reduce storm damages to the beaches and oceanfront structures along Absecon Island, Atlantic County, New Jersey.

D. General Description of Dredged or Fill Material

1. The proposed dredged material is medium to fine sand with little or no gravel present. Clay, silt, and organic content are low with neutral pH and low fertility. This material has been trapped by a combination of tidal and littoral forces and has been exposed to a high energy circulation regime.

2. The quantity required is estimated to be approximately 6.2 million cubic yards initially, with approximately 1,666,000 cubic yards every 3 years comprising periodic nourishment over a 50-year project life.

3. Three borrow areas were proposed as sources of the borrow material for this project. One area is located within Absecon Inlet and covers approximately 345 acres. The second area is located offshore, slightly southeast of the Inlet and is approximately 218 acres. The third area is located within Great Egg Harbor Inlet, covering approximately 190 acres. The total acreage available within these sites is 753 acreas. It is proposed that all material needed for the initial beach fill will be obtained from the Absecon Inlet borrow area. Depending on the rate of sedimentation in the borrow area, this will also be the first choice for subsequent nourishment activities.

E. Description of the Proposed Discharge Site

1. The proposed location is depicted in Figures 2 and 3 of the FEIS.

2. The proposed discharge site is comprised of an eroding berm, with a minimum design width of 200 feet in Atlantic City and 100 feet in Ventnor, Margate, and Longport.

3. The proposed discharge site is unconfined with placement to occur on a shoreline area.

4. The type of habitat present at the proposed location is a coastal intertidal and nearshore habitat.

5. Berm and dune restoration will be accomplished by beach nourishment. This plan will require approximately 6.2 million cubic yards of sand for initial beachfill placement, with approximately 1,666,000 cubic yards for periodic re-nourishment every 3 years over a 50 year

project life. The proposed plan includes approximately 7 miles of beachfill extending from Absecon Inlet to Great Egg Harbor Inlet. The proposed beach nourishment will result in a 200 foot wide berm with a top elevation of +8.5 feet NGVD29 in Atlantic City, and a 100 foot wide berm with a top elevation of +8.5 feet NGVD29 in Ventnor, Margate, and Longport. The beachfill will be transitioned from a 200 foot berm to a 100 foot berm between Atlantic City and Ventnor for a distance of 1000 feet. In Ventnor, Margate, and Longport, dunes will also be constructed to a top elevation of +14 feet NGVD29, with a 25 foot top width, and side slopes of 1V:5H. In Atlantic City, the dune will have a top elevtion of +16 feet NGVD29, a 25 foot top width, and side slopes of 1V:5H.

F. Description of Disposal Method

A hydraulic dredge or hopper dredge would be used to excavate the borrow material from the borrow area(s). The material would be transported using a pipeline delivery system to the beachfill placement site. Subsequently, final grading would be accomplished using standard construction equipment.

II. FACTUAL DETERMINATION

A. Physical Substrate Determinations

1. The final proposed elevation of the beach substrate after fill placement would be +8.5 feet NGVD29 at the top of the berm. The proposed profile would have a foreshore slope of 30H:1V and an underwater slope that parallels the existing bottom to the depth of closure.

2. The sediment type involved would be sand.

3. The planned construction would establish a construction template which is higher than the final intended design template or profile. It is expected that compaction and erosion would be the primary processes resulting in the change to the design template. Also, the loss of fine grain material into the water column would occur during the initial settlement.

4. The proposed construction would result in removal of the benthic community from the borrow area, and burial of the existing beach and nearshore communities when this material is put in place during berm construction.

5. Other effects would include a temporary increase in suspended sediment load and a change in the beach profile, particularly in reference to elevation.

6. Actions taken to minimize impacts include selection of fill material that is similar in nature to the pre-existing substrate. Also, standard construction practices to minimize turbidity and erosion would be employed.

B. Water Circulation, Fluctuation, and Salinity Determinations

1. Water. Consider effects on:
    - a. Salinity - No effect.
    - b. Water chemistry - No significant effect.
    - c. Clarity - Minor short-term increase in turbidity during construction.
    - d. Color - No effect.
    - e. Odor - No effect.
    - f. Taste - No effect.
    - g. Dissolved gas levels - No significant effect.
    - h. Nutrients - Minor effect.
    - i. Eutrophication - No effect.
    - j. Others as appropriate - None.
2. Current patterns and circulation
    - a. Current patterns and flow - Circulation would only be impacted by the proposed work in the immediate vicinity of the borrow area, and in the beach zone where the existing circulation pattern would be offset seaward the width of the beach nourishment.
    - b. Velocity - No effects on tidal velocity and longshore current velocity regimes.
    - c. Stratification - Thermal stratification occurs beyond the mixing region created by the surf zone. There is a potential for both winter and summer stratification. The normal pattern should continue post construction of the proposed project.
    - d. Hydrologic regime - The regime is largely marine and oceanic. This will remain the case following construction of the proposed project.
3. Normal water level fluctuations - The tides are semidiurnal with a mean tide range of 4.1 feet and a spring tide range of 5.0 feet in the ocean. Construction of the proposed work would not affect the tidal regime.

4. Salinity gradients - There should be no significant effect on the existing salinity gradients.

5. Actions that will be taken to minimize impacts- None are required: however, the borrow area would be excavated in a manner to approximate natural ridge slopes to ensure normal water exchange and circulation. Utilization of sand from a clean, high energy environment and its excavation with a hydraulic dredge would also minimize water chemistry impacts.

C. Suspended Particulate/Turbidity Determinations

1. Expected Changes in Suspended Particulates and Turbidity Levels in the Vicinity of the Disposal Site and Borrow Site - There would be a short-term elevation of suspended particulate concentrations during construction phases in the immediate vicinity of the dredging and the discharge. Elevated levels of particulate concentrations at the discharge locations may also result from "washout" after beachfill is placed.

2. Effects (degree and duration) on Chemical and Physical Properties of the Water Column -

    a. Light penetration - Short-term, limited reductions would be expected at the borrow and disposal sites from dredge activity and berm washout, respectively.

    b. Dissolved oxygen - There is a potential for a decrease in dissolved oxygen levels but the anticipated low levels of organics in the borrow material should not generate a high, if any, oxygen demand.

    c. Toxic metals and organics - Because the borrow material originates from a clean, high energy environment, and because it is essentially all medium to fine sand, no toxic metals or organics are anticipated.

    d. Pathogens - Pathogenic organisms are not known or expected to be a problem in the borrow or disposal area.

    e. Aesthetics - Construction activities and the initial construction template associated with the fill site would result in a minor, short-term degradation of aesthetics.

3. Effects on Biota

   a. Primary production, photosynthesis - Minor, short-term effects related to turbidity.

   b. Suspension/filter feeders - Minor, short-term effects related to suspended particulates outside the immediate deposition zone. Sessile organisms would be subject to burial if within the deposition area.

   c. Sight feeders - Minor, short-term effects related to turbidity.

4. Actions taken to minimize impacts include the selection of clean sand with a small fine grain component and a low organic content. Standard construction practices would also be employed to minimize turbidity and erosion.

D. Contaminant Determinations

The discharge material is not expected to introduce, relocate, or increase contaminant levels at either the borrow or placement sites. This is assumed based on the characteristics of the sediment, the proximity of the borrow site to sources of contamination, the area's hydrodynamic regime, and existing water quality.

E. Aquatic Ecosystem and Organism Determinations

1. Effects on Plankton - The effects on plankton should be minor and mostly related to light level reduction due to turbidity. Significant dissolved oxygen level reductions are not anticipated.

2. Effects on Benthos - Although there is a major disruption of the benthic community in the borrow area when the fill material is excavated, the 404(b)(1) analysis focuses on the disposal area effects. Here the disruption is significant as the entire community is subject to burial or displacement; however, the actual biomass of organisms impacted is far less due to the harsher environmental conditions present on the beach and in the surf zone. The loss is somewhat offset by the expected rapid opportunistic recolonization from adjacent areas that would occur following cessation of construction activities. Recolonization is expected to occur in the disposal (beachfill placement) area through horizontal and in some cases vertical migrations of benthos.

3. Effects on Nekton - Only a temporary displacement is expected as the nekton would probably avoid the active work area.

4. Effects on Aquatic Food Web - Only a minor, short-term impact on the food web is anticipated. This impact would extend beyond the construction period until the recolonization of buried areas had occurred.

5. Effect on Special Aquatic Sites - No special aquatic sites are to be significantly impacted.

6. Threatened and Endangered Species - The piping plover (Charadrius melodus), a Federal and State threatened species, could potentially be impacted by the proposed project. This bird nests on the beach, however, no nesting sites have been observed within the project area. Several species of threatened and endangered sea turtles may be migrating through the sand borrow area depending on the time of year. Sea turtles have been known to become entrained and subsequently destroyed by suction hopper dredges. Use of a hopper dredge during a time of high likely presence in the area could potentially entrain and destroy a sea turtle(s).

7. Other Wildlife - The proposed plan would not affect other wildlife.

8. Actions to minimize impacts - Impacts to benthic resources can be minimized at the borrow area by dredging in a manner as to avoid the creation of deep pits, using one borrow area as the primary source of initial fill, and alternating locations of periodic dredging. Impacts to Federal and State threatened piping plover can be avoided or minimized by establishing a buffer zone around a piping plover nest(s) and limiting construction outside of the nesting season. Depending on the timing of the dredging and the type of dredge to be used, potential impacts to Federal and State threatened or endangered sea turtles can be minimized by employing NMFS approved sea turtle monitors, hardened dragarm deflectors, and trawling.

F. Proposed Disposal Site Determinations

1. Mixing Zone Determination

   a. Depth of water - 0 to 20 feet mean low water
   b. Current velocity - Generally under 3 feet per second
   c. Degree of turbulence - Moderate

d. Stratification - None
e. Discharge vessel speed and direction - Not applicable
f. Rate of discharge - Typically this is estimated to be 780 cubic yards per hour
g. Dredged material characteristics - medium-fine sand
h. Number of discharge actions per unit time - Continuous over the construction period

2. Determination of compliance with applicable water quality standards - Prior to construction, a Section 401 Water Quality Certificate and consistency concurrence with the State's Coastal Zone Management Program will be obtained from the State of New Jersey.

3. Potential Effects on Human Use Characteristics -

a. Municipal and private water supply - No effect
b. Recreational and commercial fisheries - Short-term effect during construction; there would be a loss of surf clam stocks within the borrow area from dredging.
c. Water related recreation - Short-term effect during construction
d. Aesthetics - Short-term effect during construction
e. Parks, national and historic monuments, national seashores, wilderness areas, etc. - No effect

G. Determination of Cumulative Effects on the Aquatic Ecosystem- None anticipated.

H. Determination of Secondary Effects on the Aquatic Ecosystem Any secondary effects would be minor and of short duration.

III. FINDINGS OF COMPLIANCE OR NON-COMPLIANCE WITH THE RESTRICTIONS ON DISCHARGE

A. No significant adaptation of the Section 404(b)(1) Guidelines were made relative to this evaluation.

B. The alternative measures considered for accomplishing the project objectives are detailed in Section 3 of the document of which this 404(b)(1) analysis is a part.

C. A water quality certificate will be obtained from the New Jersey Department of Environmental Protection.

D. The proposed beach nourishment will not violate the Toxic Effluent Standards of Section 307 of the Clean Water Act.

E. The proposed beach nourishment will comply with the

Endangered Species Act of 1973. Informal coordination procedures have been completed.

F. The proposed beach nourishment will not violate the protective measures for any Marine Sanctuaries designated by the Marine Protection, Research, and Sanctuaries Act of 1972.

G. The proposed beach nourishment will not result in significant adverse effects on human health and welfare, including municipal and private water supplies, recreation and commercial fishing, plankton, fish, shellfish, wildlife, and special aquatic sites. Significant adverse effects on lifestages of aquatic life and other wildlife dependent on aquatic ecosystems; aquatic ecosystem diversity, productivity, and stability; and recreational, aesthetic, and economic values will not occur.

H. Appropriate steps to minimize potential adverse impacts of the discharge on aquatic systems include selection of borrow material that is low in silt content, has little organic material, and is uncontaminated.

I. On the basis of the guidelines, the proposed disposal site for the dredged material is specified as complying with the requirements of these guidelines, with the inclusion of appropriate and practical conditions to minimize pollution or adverse effects on the aquatic ecosystem.

9.0 CLEAN AIR ACT STATEMENT OF CONFORMITY

CLEAN AIR ACT
STATEMENT OF CONFORMITY
BRIGANTINE INLET TO GREAT EGG HARBOR INLET
ABSECON ISLAND INTERIM STUDY
ATLANTIC COUNTY, NEW JERSEY

Based on the conformity analysis in the subject report I have determined that the proposed action conforms to the applicable State Implementation Plan (SIP), the Environmental Protection Agency had no adverse comments under their Clean Air Act authority. No comments from the air quality management district were received during coordination of the draft feasibility report. The proposed project would comply with Section 176 (c)(1) of the Clean Air Act Amendments of 1990.

6 Aug 96
Date

Robert B. Keyser
Lieutenant Colonel, Corps of Engineers
District Engineer

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CONCLUSIONS

As a requirement in completing the feasibility study, a public notice shall be issued to inform all interested parties of the plan discussed herein. Because the design of the recommended plan is not technically complex and is essentially complete, a typical Design Memorandum would not be required before the initiation of construction. The only technical work remaining consists of additional geotechnical sampling/testing of the borrow site to finalize the site dimensions of the sand source for initial beachfill, and final environmental coordination and documentation which can be accomplished concurrent with preparation of plans and specifications for construction. In the event this study leads to Federal construction, the costs for these activities shall be reimbursed by the non-Federal sponsor as a project cost shared item.

The recommended storm damage reduction plan generally extends the entire oceanfront length of Absecon Island, and portions of Atlantic City's inlet frontage, for a total length of 44,425 feet, and consists of:

- For Atlantic City, a berm extending seaward 200 ft. from the design line at an elevation of +8.5 ft. NGVD. For Ventnor, Margate and Longport, a berm extending seaward 100 ft from the design line at an elevation of +8.5 ft. NGVD. Both berm plans have a foreshore slope of 1V:30H to mean low water (MLW). From MLW seaward the slope parallels the bottom out to the depth of closure.

- On top of the berm plans would be constructed a dune with a top width of +16 ft. NGVD and a top width of 25 ft. in Atlantic City and a dune with a top elevation of +14 ft. NGVD and a top width of 25 ft. in Ventnor, Margate and Longport. The landward and seaward slope of the dune face is 1V:5H.

- A total sand fill quantity of 6,174,000 cubic yards is needed for the initial fill placement.

- Two sections of timber bulkhead with stone revetment 1) from Oriental Avenue to Atlantic Avenue totaling 1,050 l.f. and 2) from Madison Avenue to Melrose Avenue totaling 550 l.f. Both bulkheads are designed with a top elevation of +14 ft. NGVD.

- 91 acres of planted dune grass and 63,675 l.f. of sand fence for entrapment of sand on the dune and delineating walkovers and vehicle access ramps would be required. Dune walkovers and vehicle access ramps over the dune will be maintained in their present fashion.

- Renourishment of approximately 1,666,000 cubic yards of sand fill from the offshore borrow area every 3 years for the 50 year project life.

- Beachfill for the proposed project is available from three offshore borrow areas containing approximately 20,050,000 cubic yards of suitable beachfill material. The borrow areas are located 1) approximately 1 mile offshore of Longport, 2) Absecon Inlet and 3) approximately 1 mile offshore of Atlantic City.

- To properly assess the functioning of the proposed plan, monitoring of the placed beachfill, borrow areas, shoreline, wave and littoral environment is included with the plan. Environmental monitoring is being addressed through coordination with other interested agencies, and is included in the Final Environmental Impact Statement for the project.

If this project were to go to construction, the Federal Government would contribute 65% of the first cost of the selected plan, which is currently estimated to be $52,146,000. Periodic nourishment of the selected plan would be similarly cost shared.

The plan described above is subject to modification at the discretion of the Commander, HQUSACE.

RECOMMENDATION

In making the following recommendation, I have given consideration to all significant aspects in the overall public interest, including environmental, social effects, economic effects, engineering feasibility and compatibility of the project with the policies, desires and capabilities of the State of New Jersey and other non-Federal interests. A plan has been identified that is technically sound, economically justified, and socially and environmentally acceptable; however, the current Administration's budgetary policy precludes further Federal participation in the design and construction of hurricane and storm damage reduction projects.

The recommendations contained herein reflect the information available at the time and current Departmental policies governing formulation of individual projects. These recommendations may be modified before they are transmitted to the Congress. However, prior to transmittal to the Congress, the Sponsor, the States, interested Federal agencies, and other parties will be advised of any modifications and will be afforded an opportunity to comment further.

Robert B. Keyser
Lieutenant Colonel, Corps of Engineers
District Engineer

APPENDIX B

BRIGANTINE INLET TO GREAT EGG HARBOR INLET FEASIBILITY STUDY
ABSECON ISLAND
ECONOMICS APPENDIX

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INTRODUCTION

The following section details the economic analysis performed to evaluate the damages for the without projections on Absecon Island. Benefit categories to be evaluated will eventually include reduction in storm, wave & inundation damages, and increases in recreation usage and/or value. The basic underlying assumptions include a discount rate of 7⅝%, March 1994 price level, a 50 year project life, and a base year of 2001. Project benefits were updated to an October 1995 price level for comparison with plan alternative cost estimates.

DESCRIPTION OF THE STUDY AREA

POPULATION AND LAND USE

Absecon Island is comprised of four communities; Atlantic City, Longport, Margate and Ventnor, all of which are located within Atlantic County's 565 square miles. The study area is bordered by Absecon Inlet to the north and Great Egg Harbor Inlet to the south.

Atlantic County is the 6th least populated county within New Jersey with a total population of 224,327 year round residents in 1990, equalling only 2.5% of the state's permanent population. Although Atlantic County covers 565 square miles, approximately three-quarters of the residents live within five miles of the ocean. Early development along these beach front communities are currently causing slow growth trends to occur within the study area's boundaries. Despite these slow growth rates, over 85% of seasonal residents in Atlantic County are concentrated in the island communities of Atlantic City, Brigantine, Longport, Margate, Ventnor and the backbay communities of Absecon, Linwood, Northfield and Sommers Point.

These communities rely heavily on the tourist industry for their economic stability. Although South Jersey is largely responsible for supporting the "Garden State" image, 62.9% of Atlantic County residents depend on service and sale oriented companies while only 0.42% of the work force is employed in farming, fishing or forestry.

Within the county, Atlantic City is the most heavily developed community with a population of 40,199 year-round residents in 1990 and 3,347.71 people per square mile accounting for 2/3 of the study area's population. Between 1980 and 1990 however, Atlantic City experienced a decline of 5.6% lowering the population to 37,986. The population is expected to continue to decline into the year 2000 when it will rise to approximately 40,450.

New development has slowed over recent years. In 1991 only one new privately owned housing unit was authorized by building permits in comparison to the 39 units authorized in 1990. This is largely due to the lack of vacant land as only 6% of the total property was vacant by the year 1993. Unlike the majority of the study area, Atlantic City is heavily commercialized composing 76.8% of the tax base with only 14.28% residential. Atlantic City's beaches are primarily lined with commercial buildings such as hotels, casinos, and shops, while Longport, Margate and Ventnor remain mostly residential.

The casinos have helped make the Atlantic City boardwalk famous while helping to attract a total of 3.2 million visitors in 1993 alone. Not only have the casinos helped the city bring in needed tourist related jobs, but they have also helped to rebuild the neighboring communities by forming an organization called the Casino Reinvestment Development Authority (CRDA). In conjunction with the CRDA, Atlantic City has planned a $42 million housing rehabilitation program, which began construction in October 1993. The program will provide 198 housing units on a 15 acre track of land in the Inlet section of Atlantic City. Construction cost per unit is approximately $170,000, however subsidies from the CRDA will allow qualified residents to purchase the townhouses at a selling price between $70,000 and $80,000 placing it within range of the median value for single homes which was $73,400 in 1990.

This development represents the second phase of a $500 million redevelopment of the North-East inlet which is expected to be complete within approximately 10 years. The program will result in 2,500 new or rehabilitated housing units, commercial space and recreational areas. These renovated homes will be a great help to a city that has one of the highest unemployment rates along the Jersey shore. Atlantic City had a median household income of only $20,309 in 1989 and an unemployment rate of 5.5% with 9,208 people living below the poverty line, accounting for almost 25% of the residents.

The third phase of the CRDA redevelopment plan involves the construction of low-rise (townhouses) and mid-rise (approximately 100-150 units) residential structures in three tax blocks located along the Inlet frontage. CRDA has acquired the necessary property, performed site remediation, and expects construction to begin in 1996. Another major component of the Inlet renewal effort is the development of the Maine Avenue County Park. The park will extend from the waters edge to New Hampshire Avenue, a recently improved major access road. It will include ample landscaping, a pavilion, and parking area with a cove, and passive waterfront park at the waters edge.

The city is also planning to build a new convention center directly off the Atlantic City Expressway, and plan to have a water and amusement ride theme park serve as a gateway corridor between the new convention center and the casinos (Bally's Caesars, and Trump Plaza). While this new development is largely on the bay, it may impact our study area by bringing more visitors to the beach.

To the south of Atlantic City is Ventnor, a resort city with a boardwalk and approximately 1.5

square miles of public beach which nearly 28,000 summer residents came to enjoy in 1993. Ventnor's population has also declined over the past decade by approximately 6% to 11,005 in 1990. It is projected that population will continue to decline by 5% until the year 2000 to a total of 10,418.

Because of the town's proximity to Atlantic City, Ventnor is also very highly developed, with a total of 5,135 residents per square mile. In 1991 there were only three building permits issued for single family units compared to 27 permits authorized in 1989. The community is primarily residential with only 2 industrial complexes and 141 commercial lots within the city's boundaries. Along the boardwalk are several high rise condominium complexes and hotels. However, traveling south away from Atlantic City, the area becomes more residential with single family homes along the beach-front rather than commercial lots. The median value of a single family home was $137,700 in 1990, almost twice the value of residential homes in Atlantic City.

Bordering Ventnor to the south is Margate. Unlike Ventnor and Atlantic City, Margate is more of a residential community. Margate encompasses 1.41 square miles of land. Neither Margate nor Longport own boardwalks, however all of their beaches allow public access. The beach front is almost solely residential with only a few commercial and public buildings, including a senior citizens center and a public library. There are 6,726 total housing units, of which 45% are owner occupied. The median value for single family homes is $176,800 while median rent is $564.

Population has consistently declined over the last 30 years from 10,576 permanent residents in 1970 to only 8,431 in 1990. This trend is expected to continue into the year 2010 when it will fall to 7,315.

Like all of the cities in the study area Margate is a primarily service oriented labor force. Out of 4,563 civilian employees, 53% are service oriented with only .15% in the farming, fishing and forestry industry. The median income per household in 1989 was $40,649 with only 286 residents living below the poverty line.

The last town in the study area is Longport which lies between Margate and Great Egg Harbor Inlet. Longport is a small, quiet, residential community with older residents. The median age is 58.4 years and more than half of the residents are retired. There are no boardwalks or amusement parks to attract the younger crowd, however there are approximately 1.24 square miles of public access beaches which bring in nearly 6,000 summer residents and 1,224 year-round residents.

There are 1,537 housing units with a total of 1,058 single family units and 479 multi-family units. The borough is almost completely developed with only 5% of the land remaining vacant for future development. The study area is primarily zoned for residential single family units, however there is one commercial lot and one multi-family unit along Beach Avenue. The median value for a single family home was $201,800 in 1993.

Table 1

CURRENT POPULATION		
NAME	SUMMER POPULATION/1	1990 POPULATION/2
Atlantic County	360,132	224,327
Atlantic City	3.2 million visitors (annually)	37,986
Longport	6,000	1,224
Margate	24,000	8,431
Ventnor	28,000	11,005

Notes:
1 Based on interviews with local officials.
2 The New Jersey Municipal Data Book 1994, consistent with the 1990 Census.

The Atlantic County Division of Economic Development projects that Atlantic County population will increase by 9.7% between 1990 and 2000, and by 8.5% between 2000 and 2010. Within Atlantic County Longport, Margate and Ventnor are expected to grow at slow rates, while Atlantic City is expected to experience mild to moderate growth.

Table 2

POPULATION PROJECTIONS					
	1990	1995	2000	2005	2010
Atlantic County	224,327	233,075	246,153	256,617	67,080
Atlantic City	37,986	38,972	40,450	41,696	42,941
Longport	1,224	1,175	1,102	1,084	1,066
Margate	8,431	8,090	7,578	7,447	7,315
Ventnor	11,005	10,770	10,418	10,411	10,404

Table 3

INCOME FOR 1989				
NAME	PER CAPITA INCOME	MEDIAN HOUSEHOLD INCOME	MEDIAN FAMILY INCOME	PERSONS BELOW POVERTY
Atlantic City	12,017	20,309	27,804	9,208
Longport	23,737	34,464	45,288	107
Margate	27,939	40,649	54,949	286
Ventnor	19,038	33,120	43,414	727

Source: The New Jersey Municipal Data Book 1994 published by the U.S. Census

STORM DAMAGE ECONOMIC ANALYSIS

STRUCTURE INVENTORY AND REPLACEMENT COSTS

The study area was delineated into the following three reaches: (1.) the inlet area of Atlantic City, (2.) the oceanfront of Atlantic City, and (3.) Ventnor, Margate and Longport based on the physical setting, hydraulic and economic factors. All analyses were done on a reach by reach basis and used to calculate without project total damages.

A database of approximately 330 ocean block structures in Longport, 330 in Margate, 230 in Ventnor, 310 in Atlantic City on the oceanfront and 45 on the inlet frontage of Atlantic City was compiled containing information described in the following paragraphs. Each structure was specifically inventoried and mapped on aerial photography at a scale of 1"=50'. Information collected includes address, construction and quality type, and number of stories, first floor elevations, ground elevations and foundation type. For multi-family residential and commercial structures the number of units and names of businesses were also gathered. The assimilation of this data was enhanced by using aerial ortho-digital mapping and the geographic information system, MIPS (Micro Imaging Processing System). This information, along with quality and condition of a structure, was entered into the Marshall and Swift Residential and Commercial Software Estimators which calculates depreciated replacement cost value. Only the replacement cost value for the first two floors (vulnerable to storm damage) of high rise buildings and casinos were entered into the database and used to estimate damages. The associated content value of each structure is 40% of the structural replacement cost.

The structure inventory consists of single family homes, multi-family dwellings such as apartment and condominium buildings, and commercial establishments such as hotel-casinos, multi-unit retail structures, arcades, malls and office and public buildings. Local officials, and redevelopment agencies have embarked upon substantial development plans for the Inlet area. Almost 200 townhouses have been constructed recently. Land acquisition and remediation has been conducted to commence construction of two mid-rise multi-unit complexes of similar construction to an existing multi-unit building (Ocean Terrace) in the area, and conceptual plans for a water park have been designed.

In Atlantic City, the inclusion of multi-unit commercial structures may result in higher equivalent annual damages than a database weighted with more residential structures. The database consists of over 30 structures classified as hotels/casinos, a shopping mall, and a convention center. The estimated total replacement cost for all structures is over 600 million dollars and contain 200 million dollars in content replacement cost. The average replacement cost for residential structures included in the database for Atlantic City Inlet, Atlantic City Oceanfront, and Ventnor, Margate, Longport are $196,000, $248,000, and $294,000, respectively. The average replacement cost for commercial structures and contents (hotels/casinos; malls, etc.) included in the database for Atlantic City Inlet, Atlantic City Oceanfront, and Ventnor, Margate, Longport are $3.9, $2.9, and $1.8 million, respectively. The inventory of structures in each area extended approximately one block from the oceanfront or inlet frontage.

The communities of Ventnor, Margate, and Longport were evaluated as one unit due to their similarities. Land-use is primarily residential with relatively few commercial lots in proximity to the ocean. Most commercial activities are located in the resort city of Ventnor. Development is continuous along the oceanfront of Ventnor, Margate, and Longport. As shown in the table below, several hydraulic parameters or shoreline characteristics are also comparable.

Characteristics	**Ventnor**	**Margate**	**Longport**
# of Structures/Mile	137	199	235
Type of Development	residential	residential	residential
Long Term Erosion Rate	0 ft/yr.	0 ft/yr.	0 ft/yr.
Direction of Littoral Transport	southwest	southwest	southwest
Orientation of Shoreline	northeast to southwest	northeast to southwest	northeast to southwest
Seawall/Bulkhead Fails	100 year event	100 year event	100 year event
Primary Damage Mechanism	wave-inundation	wave-inundation	wave-inundation

STORM DAMAGE METHODOLOGY

Damages (for without and with project conditions) were calculated for seven frequency storm events (5, 10, 20, 50, 100, 200, and 500 year events) for erosion, wave and inundation damage to structures, infrastructure and improved property. The calculations were performed using COSTDAM. COSTDAM is a Fortran program originally written by the Wilmington District and updated for the Philadelphia District. COSTDAM reads an ASCII 'Control' file which contains the storm frequency parameters for each cell and an ASCII 'Structure' file which contains the database information of each structure as previously described. A sample of this structure file is below in Table 4. COSTDAM checks if a structure has been damaged by wave attack, based on the relationship between a structure's first floor elevation and the total water elevation that sustains a wave. Then COSTDAM checks for erosion damage at a structure. Finally, COSTDAM calculates inundation damages if the water elevation is higher than the first floor elevation based on FIA depth-damage curves adjusted for increased salt water damageability. To avoid double counting, if damage occurs by more than one mechanism, COSTDAM takes the maximum damage of any given mechanism (wave, erosion, inundation) and drops the rest of the damages from the structure's total damages. (See Figure 1 for illustration.) Average annual damages are calculated for each reach.

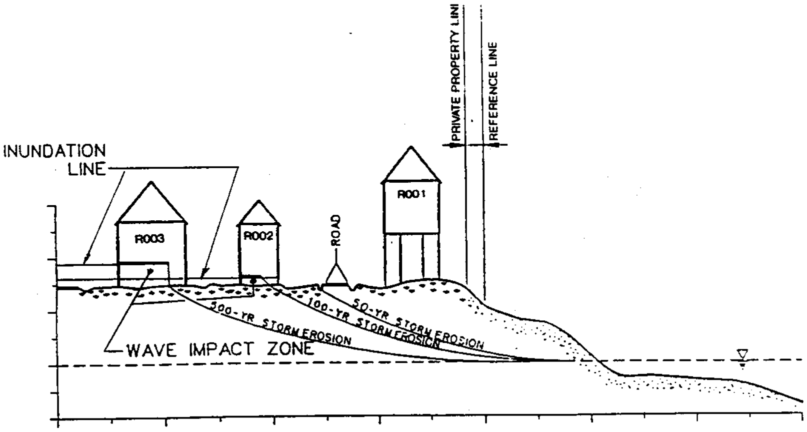
Table 4
STRUCTURE FILE EXCERPT

```
V152230          271.3  289.2 10.9 4.0   221.   88.S03S04 1-1
V152231          309.6  332.7 10.5 7.0   290.  116.S07S08 1-1
V152232          370.0  389.3 10.4 3.2   293.  117.S03S04 1-1
V152233          416.1  436.7 10.4 3.1   188.   75.S03S04 1-1
M163000           418.8  436.8  9.7 3.9   237.   95.S03S04 1-1
M163001           368.1  386.3 12.4 2.5   250.  100.S03S04 1-1
M163002           307.9  331.4 10.3 0.3   266.  106.S07S08 1-1
M163003           256.3  280.9 10.6 2.7   298.  119.S07S08 1-1
M163004           218.9  235.9 10.4 3.1   273.  109.S03S04 1-1
M163005           212.2  225.2 10.4 2.7   256.  102.S03S04 1-1
M163006           264.5  281.7 10.8 3.6   322.  129.S07S08 1-1
```

Columns 1-3 contain the Cell ID (format-A3).
Columns 4-9 contain the Structure ID (format-A6).
Columns 10-19 are blank.
Columns 20-27 contain distance to front of structure (format-F8.1)
Columns 28-35 contain distance to middle of structure (format-F8.1)
Columns 36-40 contain the ground elevation (format-F5.1)
Columns 41-44 contain the distance between the first floor and the ground (format-F4.1)
Columns 45-53 contain the structure replacement cost value (format,-F9.0)
Columns 54-62 contain content replacement cost value (format-F9.0)
Columns 63-65 contain the structure depth damage curve (format-A3)
Columns 66-68 contain the content depth damage curve (format-A3)
Columns 69-70 contain a code to make structure "active" (format-I2)
Columns 71-72 contain the damage category (format-I2)

FIGURE 1

Without Project Damage Mechanisms



CROSS-SECTION VIEW WITHOUT PROJECT

PERCENT DAMAGED						
HOUSE	50 YEAR STORM		100 YEAR STORM		500 YEAR STORM	
	EROSION	WAVE / INUN.	EROSION	WAVE / INUN.	EROSION	WAVE / INUN.
R001	100%	0	100%	0	100%	0
R002	0	1%	50%*	13%	100%	0
R003	0	1%	0	13%	57%*	28%

* TAKE SINGLE HIGHEST DAMAGE PERCENTAGE ONLY TO PREVENT DOUBLE COUNTING

EROSION DAMAGES

The distance between the reference (profile) line and the oceanfront and back walls were measured in AutoCAD using the georeferenced MIPS mapping of the study area. This technique reduces the amount human error and photographic distortion relative to the technique used in the reconnaissance study. For the structure damage/failure analysis, it was assumed that a structure is destroyed at the point that the land below the structure is eroded halfway through the structure's footprint if the structure is not on a pile foundation. If the structure is on piles, the land below the structure must have eroded through the footprint of the structure before total damage is claimed. Prior to this, for both foundation types, the percent damage claimed is equal to the linear proportion of erosion under the structure's footprint relative to the total damage point. For townhouse/rowhouse structures perpendicular to the ocean, each unit has a unique ocean and back wall distances due to the local building ordinance which mandates that every unit have two hour firewalls. These walls should provide enough stability that townhouse units in a building can remain standing and be utilized after the unit(s) closer to the ocean is/are damaged. This has no bearing on townhouse units parallel to the ocean which would all have the same erosion point, because they are essentially equal distance from the reference line. Other multi-family structures such as apartments and condominiums will not have unique erosion points for each unit, because most of these structures were built before the local ordinance mandating firewalls was in place. Large high rise structures such as apartment buildings, hotels and casinos are not subjected to total erosion damage by undermining because of their deep piled foundations.

In addition to erosion damage to structures, damage to the land the structures are on (hence forth called improved property) was calculated. The improved property value was determined by comparing market value of the improved property to the cost of filling in the eroded land for reutilization and using the least expensive of the two values. The cost of filling/restoring the improved property is based on a typical 100'x50' lot for the different depths, widths and cubic yards of erosion produced by storms. The cost of filling/restoring the eroded improved property was determined to be the cheaper of the two and the cost of fill was prorated for the width of each reach to estimate total damages.

Erosion damages for infrastructure are also calculated. The infrastructure damage category included damage to roads, utilities, the boardwalk, bulkhead, and geotubes. The replacement cost of infrastructure does not necessarily relate to the number of structures in the area. Road and utilities replacement costs consisted of fixed and variable costs based on ranges of feet of replacement/repair. In general, the replacement cost of roads decreased with greater quantities eroded reflecting economies of scale. Distance from a reference line (back of the boardwalk) and feet of erosion per event for each road and associated utilities were used to determine damage susceptibility. Atlantic City alone has over sixty streets which are perpendicular to the boardwalk.

The boardwalk in Atlantic City is approximately 18,000 feet long and ranges in width from 20 feet to 60 feet, for which replacement costs ranged from $315 to $3,925 per linear foot. The following criteria were used to determine boardwalk damage susceptibility: if (1) the reference point for the boardwalk was within the wave zone for an event; (2) the wave zone extended beyond the front of the boardwalk; and (3) the water elevation was greater than or equal to the boardwalk elevation. Bulkhead damage was based on selection by hydraulic engineers of a probable damage/failure event. Costs to replace bulkheads are estimated to be $900 per linear foot. Geotubes were installed on the beach in Atlantic City for erosion protection at an approximate cost of $57 per linear foot. Geotube failure was determined to occur by the 50-year storm event.

Damage to infrastructure and the boardwalk in particular has historically been significant, especially in Atlantic City. Boardwalk damage constituted 40% of the $330,000 in municipal damages caused by the March 1984 storm. The December 1992 storm caused approximately $1.2 million dollars in municipal damage to Atlantic City. Several hundred feet of the boardwalk was destroyed or damaged. These damage estimates represent claims considered eligible by the Federal Emergency Management Agency (FEMA) and not all costs incurred from the storms.

WAVE-INUNDATION DAMAGES

A structure is considered to be damaged by a wave when there is sufficient force in the total water elevation to completely damage a structure. Partial wave damages are not calculated; instead the structure is subjected to inundation damages. Large masonry structures like high rise condominiums are not expected to experience failure by wave damage. Because of the dominance of such structures along the oceanfront in Atlantic City no wave damages are present. On the contrary, the residential communities of Ventnor, Margate, and Longport have typical frame single family beach house along the oceanfront that do experience wave damage.

The percentages of total replacement cost used to calculate damages by the depth-damage function curves for inundation damages reflect various characteristics of a structure. The depth-damage curves display the percent damaged at various depths relative to the first floor. Examples of the depth-damage curves are displayed in Table 5. The depth-damage curves used to estimate the damage to structures were derived from previous studies of saltwater areas and Federal Insurance Administration (FIA) curves. The distinguishing characteristics were construction type (frame, concrete block, or masonry) and number of stories in a structure.

Table 5
DEPTH DAMAGE CURVES

```
S03 (2 story, no basement, residential structure)
# of Rows    (free format)
13
Depth Damage (expressed as a decimal)   (free format)
-2  0
-1  .01
 0  .10
 1  .24
 2  .30
 3  .36
 4  .39
 5  .42
 6  .47
 7  .49
 8  .56
 9  .64
10  .67
```

S15 (1 story, masonry, no basement, commercial structure)
# of Rows (free format)
13
Depth Damage (expressed as a decimal) (free format)
-2 0
-1 .01
0 .05
1 .21
2 .29
3 .38
4 .46
5 .48
6 .53
7 .55
8 .59
9 .67
10 .73

EMERGENCY/CLEAN-UP COSTS

Clean-up costs for individual structures are based on the time for clean-up and additional meal and travel costs. Travel and meal costs are included as opposed to evacuation costs because the vast majority of residential structures and even many commercial structures are occupied only on a seasonal basis, and even then, not by the structure's owner. Clean-up costs are only applied to those structures affected by a particular storm event.

Emergency and clean-up costs are also calculated for public entities. This includes local, county and state governments and non-profit emergency service organizations. The costs are based on FEMA Damage Survey Reports for the March 1984 and December 1992 storms, which had stage frequencies of approximately 10 and 20 year events. Emergency and clean-up costs for larger events are extrapolated due to limited historical information.

WITHOUT PROJECT CONDITIONS

IMPROVED PROPERTY DAMAGES

Annual damages for without project damages of improved property are in Table 6.

Table 6

Improved Property
Without Project Expected Annual Damage
(In $000s, Mar. 1994 Price Level)

Reach	Annual Damages
Atlantic City Inlet	0
Atlantic City Oceanfront	130
Ventnor, Margate, Longport	256
Total Improved Property Damage	386

INFRASTRUCTURE DAMAGES

The without project annual damages for infrastructure (roads, utilities, bulkhead) including boardwalk are in Table 7.

Table 7

Infrastructure
Without Project Expected Annual Damage
(In $000s, Mar. 1994 Price Level)

Reach	Annual Damages
Atlantic City Inlet	187
Atlantic City Oceanfront	2,309
Ventnor, Margate, Longport	660
Total Infrastructure Damage	3,156

STRUCTURE DAMAGES

Table 8 displays equivalent annual damages for structures in Atlantic City inlet frontage, Atlantic City oceanfront, and Ventnor, Margate, Longport, respectively. Annual damages for Atlantic City inlet and Atlantic City oceanfront are $422,000 and $2,738,000, respectively. Annual damages for Ventnor, Margate, Longport are $5,159,000.

Table 8

Structures
Without Project Expected Annual Damage
(In $000s, Mar. 1994 Price Level)

Reach	Annual Damages
Atlantic City Inlet	422
Atlantic City Oceanfront	2,738
Ventnor, Margate, Longport	5,159
Total Structure Damage	8,319

TOTAL ANNUAL DAMAGES

Total Annual Damages for structures, infrastructure and improved property is displayed by cell in Table 9.

Table 9

Total Damages for All Categories
Without Project Expected Annual Damage
(In $000s, Mar. 1994 Price Level)

Reach	Annual Damages
Atlantic City Inlet	609
Atlantic City Oceanfront	5,177
Ventnor, Margate, Longport	6,075
Total Damages	11,861

BACK BAY RESIDUAL DAMAGES

COSTDAM was also run for the stages associated with the back bay (still-water) inundation to determine the corresponding damages. The results, listed in Table 10, represent inundation damages that will not be eliminated by a project on the oceanfront of Longport. These back bay induced residual damages total $223,000 in annual damages. This avoids overestimating benefits in the with project condition for those cases where damages are reduced or eliminated for structures once eroded or damaged by wave but may still incur some damages due to inundation from the back bay.

Table 10

Longport
Back Bay Still Water Inundation
(In $000s, Mar. 1994 Price Level)

Reach	Annual Damages
Longport	$223

EMERGENCY/CLEAN-UP COSTS

The number of structures affected and the associated emergency costs for each storm event are in Table 11. Average annual damages for (all affected) individuals in Atlantic City inlet, Atlantic City oceanfront, and Ventnor, Margate, Longport are $2,000, $13,000 and $29,000, respectively. Average annual damages for (all affected) public entities are $5,000, $112,000, and $106,000 respectively.

Table 11

Structures Affected and Emergency/Clean-up Costs
(in $000s, Mar. 1994 Price Level)

ATLANTIC CITY INLET	5yr	10yr	20yr	50yr	100yr	200yr	500yr
Structures	11	12	13	15	32	35	41
Individual Clean-up Costs $	4	5	6	11	28	57	117
Municipal Clean-up Costs $	3	6	25	50	103	227	289
ATLANTIC CITY OCEANFRONT	5yr	10yr	20yr	50yr	100yr	200yr	500yr
Structures	31	69	114	174	199	231	254
Individual Clean-up Costs $	12	27	44	111	231	475	959
Municipal Clean-up Costs $	87	174	717	1062	2417	3379	5330
VENTNOR, MARGATE, LONGPORT	5yr	10yr	20yr	50yr	100yr	200yr	500yr
Structures	32	120	242	325	749	851	890
Individual Clean-up Costs $	12	46	93	218	600	1239	2493
Municipal Clean-up Costs $	97	194	518	705	3015	4041	4859

TOTAL AVERAGE ANNUAL CLEANUP COSTS
ATLANTIC CITY INLET:
(all) Individuals: $2,000
Public entities: $5,000

ATLANTIC CITY OCEANFRONT:
(all) Individuals: $13,000
Public entities: $112,000

VENTNOR, MARGATE, LONGPORT:
(all) Individuals: $29,000
Public entities: $106,000

WITH PROJECT ALTERNATIVES

STORM DAMAGE REDUCTION

Damages for eleven with project alternatives are calculated using the same methodologies and databases as previously detailed in the without project conditions. The benefits for any given project are the difference between without project damages and with project damages. The storm damage reduction benefits (including emergency costs) are shown for all eleven alternatives in Table 12.

Table 12

Atlantic City Inlet
Storm Damage Reduction By Alternative
(Mar. 1994 Price Level)

Alt.	Project Type[1]	Without Project Storm Damages	With Project Storm Damages	Storm Damage Reduction Benefits	Percent Reduced
ZA	Jetty Extension	$616,000	$541,220	$74,780	12%
ZB	Bulkheads	$616,000	$184,180	$431,820	70%
ZJ	Wave Breaker	$616,000	$558,050	$57,950	9%

Atlantic City Oceanfront
Storm Damage Reduction By Alternative
(Mar. 1994 Price Level)

Alt.	Berm	Dune	Without Project Storm Damages	With Project Storm Damages	Storm Damage Reduction Benefits	Percent Reduced
CW	150	Existing	$5,302,000	$3,271,850	$2,030,150	38%
CX	150	+14	$5,302,000	$1,615,980	$3,686,020	70%
CY	150	+16	$5,302,000	$1,371,860	$3,930,140	74%
DX	200	+14	$5,302,000	$1,522,420	$3,779,580	71%
DY	200	+16	$5,302,000	$1,072,830	$4,229,170	80%
DZ	200	+18	$5,302,000	$958,310	$4,343,690	82%
EY[2]	250	+16	$5,302,000	$912,040	$4,389,960	83%

---

[1] It was assumed that: (1.) the jetty extension, Alt. ZA, would totally eliminate wave damages in the Inlet; (2.) the wave breaker, Alt. ZJ, would partially eliminate wave damages; and (3.) inundation and erosion damages would not be reduced under with project conditions.

[2] In order to extrapolate with project storm damages for Alt. EY, it was assumed that: (1) wave-inundation damages for Alt. EY was the same as wave-inundation damages for Alt. DY since the dune height is the same; and (2) erosion damages for Alt. EY were eliminated due to the wider berm width.

Table 12 (cont'd.)

Ventnor, Margate, Longport
Storm Damage Reduction By Alternative
(Mar. 1994 Price Level)

Alt.	Berm	Dune	Without Project Storm Damages	With Project Storm Damages	Storm Damage Reduction Benefits	Percent Reduced
AV	75	+12.5	$6,210,000	$2,833,834	$3,376,166	51%
BX	100	+14	$6,210,000	$2,219,820	$3,990,180	61%
CW	150	Existing	$6,210,000	$4,431,060	$1,778,940	25%
CX	150	+14	$6,210,000	$2,157,020	$4,052,980	62%
CY	150	+16	$6,210,000	$1,643,870	$4,566,130	70%
DX	200	+14	$6,210,000	$2,026,430	$4,183,570	64%
DY	200	+16	$6,210,000	$1,542,290	$4,667,710	72%

OPTIMIZATION

Optimization of the alternatives is based on storm damage reduction which is the priority benefit category. Benefits were updated to an October 1995 price level. Initial and nourishment costs for the various project alternatives are annualized for comparison to the average annual benefits for a specific project alternative. Recreation benefits were not used in the optimization procedure. Initial construction, and periodic nourishment costs are annualized over a 50 year project life at 7-⅝%. The average annual costs are subtracted from average annual benefits to calculate net benefits and select the optimal plan which maximizes net benefits. Included in Table 14 are the average annual benefits and costs, the net benefits and benefit-cost ratio for storm damage reduction. Plan ZB with two bulkheads was selected for the inlet area in Atlantic City. Plan DY with a 200' berm and a dune at +16 NGVD is the optimal plan for the Atlantic City oceanfront. Plan BX with a 100' berm and a dune at +14 NGVD is the optimal plan for Ventnor, Margate, Longport.

Table 13

Atlantic City Inlet Benefit/Cost Matrix
Average Annual Benefits and Costs for With Project Alternatives
(Oct. 1995 Price Level)

		ALT. ZA
JETTY EXTENSION	AVERAGE ANNUAL BENEFITS	$77,031
	AVERAGE ANNUAL COSTS	$559,161
	BENEFIT-COST RATIO	0.14
	NET BENEFITS	($482,131)
		ALT. ZB
BULKHEADS	AVERAGE ANNUAL BENEFITS	**$444,816**
	AVERAGE ANNUAL COSTS	**$401,357**
	BENEFIT-COST RATIO	**1.11**
	NET BENEFITS	**$43,459**
		ALT. ZJ
WAVE BREAKER	AVERAGE ANNUAL BENEFITS	$59,694
	AVERAGE ANNUAL COSTS	$484,486
	BENEFIT-COST RATIO	0.12
	NET BENEFITS	($424,792)

Table 14

Atlantic City Oceanfront Benefit/Cost Matrix
Average Annual Benefits and Costs for With Project Alternatives
(Oct. 1995 Price Level)

		150' BERM	200' BERM	250' BERM
		ALT. CW		
NO DUNE	AVERAGE ANNUAL BENEFITS	$2,091,249		
	AVERAGE ANNUAL COSTS	$3,075,593		
	BENEFIT-COST RATIO	0.68		
	NET BENEFITS	($984,344)		
		ALT. CX	ALT. DX	
+14' NGVD DUNE HEIGHT	AVERAGE ANNUAL BENEFITS	$3,796,954	$3,893,330	
	AVERAGE ANNUAL COSTS	$3,127,149	$3,301,274	
	BENEFIT-COST RATIO	1.21	1.18	
	NET BENEFITS	$669,806	$592,056	
		ALT. CY	**ALT. DY**	ALT. EY
+16' NGVD DUNE HEIGHT	AVERAGE ANNUAL BENEFITS	$4,048,421	**$4,356,451**	$4,522,078
	AVERAGE ANNUAL COSTS	$3,216,410	**$3,399,153**	$3,873,690
	BENEFIT-COST RATIO	1.26	**1.28**	1.17
	NET BENEFITS	$832,011	**$957,298**	$648,388
			ALT. DZ	
+18' NGVD DUNE HEIGHT	AVERAGE ANNUAL BENEFITS		$4,474,417	
	AVERAGE ANNUAL COSTS		$3,541,844	
	BENEFIT-COST RATIO		1.26	
	NET BENEFITS		$932,573	

Table 15

Ventnor, Margate, Longport Benefit/Cost Matrix
Average Annual Benefits and Costs for With Project Alternatives
(Oct. 1995 Price Level)

		75' BERM	100' BERM	150' BERM	200' BERM
				ALT. CW	
NO DUNE	AVERAGE ANNUAL BENEFITS			$1,832,479	
	AVERAGE ANNUAL COSTS			$4,028,980	
	BENEFIT-COST RATIO			0.45	
	NET BENEFITS			($2,196,501)	
		ALT. AV			
+12.5' NGVD DUNE HEIGHT	AVERAGE ANNUAL BENEFITS	$3,477,775			
	AVERAGE ANNUAL COSTS	$3,271,404			
	BENEFIT-COST RATIO	1.06			
	NET BENEFITS	$206,370			
			ALT. BX	ALT. CX	ALT. DX
+14' NGVD DUNE HEIGHT	AVERAGE ANNUAL BENEFITS		**$4,110,268**	$4,174,958	$4,309,478
	AVERAGE ANNUAL COSTS		**$3,517,916**	$4,313,241	$4,984,092
	BENEFIT-COST RATIO		**1.17**	0.97	0.86
	NET BENEFITS		**$592,352**	($138,283)	($674,614)
				ALT. CY	ALT. DY
+16' NGVD DUNE HEIGHT	AVERAGE ANNUAL BENEFITS			$4,703,552	$4,808,189
	AVERAGE ANNUAL COSTS			$4,407,449	$5,080,370
	BENEFIT-COST RATIO			1.07	0.95
	NET BENEFITS			$296,102	($272,181)

REDUCED MAINTENANCE BENEFITS

Reduced maintenance benefits accrue under with project conditions as well as storm damage reduction benefits. As a result of the beachfill and nourishment components of the proposed plan, it is expected that the cost of maintaining and repairing the geotubes in Atlantic City will decrease by $2,000 per year.

RECREATION ANALYSIS

WITHOUT PROJECT CONDITIONS

New Jersey Beaches are consistently the number one travel destination in New Jersey. Tourist dollars contribute directly and indirectly to the regional economy. In 1992, the New Jersey Travel Research Program reported that travel and tourism generated 346,000 jobs in the state with a total payroll of $7.6 billion. In addition, the number of visitors to Atlantic City has recently experienced a slight increase. In 1994 the total number of visitors was an estimated 31.3 million according to the South Jersey Transportation Authority. This represented a 3.6% increase over the previous year's visitor count.

A contingent valuation method survey was completed by the Rutgers State University for the New Jersey Department of Environmental Protection and Energy and the U.S. Corps of Engineers to determine willingness to pay for the existing beach and an enhanced beach. This is done on a regional basis, encompassing the major beach communities of Atlantic City, Ventnor, Margate, and Longport. It consisted of 1,063 interviews of a random sample of recreational beach users. The interviews were conducted in person on the beach during the summer of 1994.

Beachgoers were asked to indicate how important different factors were in deciding whether to visit a New Jersey beach. Respondents voiced similar desires. The primary factors of consideration were the quality of the beach scenery, how well maintained the beach was, the width of the beach, the number of lifeguards, and how family oriented was the beach.

The survey also used a density measure developed in cooperation with the Corps to determine if crowding was a problem. It was found that over 60% of the time there was at least several yards of space between beach towels or blankets, and only 7% of the time was it very crowded (only 2 feet between towels). Further it was determined that crowding was not considered a very important issue to the majority of beachgoers by asking respondents how important being alone is and how important is it to be with a large number of people. As might be expected, areas with more crowding tended to be frequented by people who like large numbers. People who like to be alone frequented areas that tended to have little crowding.

To estimate the value of the beach as it exists currently, an iterative bidding process was applied. Beachgoers were first asked if a day at the beach would be worth $4.00 to each member of their household. Based on their answers, they were then asked progressively higher or lower amounts until the amount they value the beach was determined. Using this method it was found that the average value of a day at the beach is $4.22.

WITH PROJECT CONDITIONS

The beachgoers were asked how much more they were willing to pay if the beach were widened. While the majority were unwilling to pay any extra, 16% were willing to pay, on average, $2.92 more per visit. This would be equivalent to an average of $0.47 for all beachgoers.

The number of visitor days was estimated by multiplying the number of beach tag sales by the number of days the tags are usable. This was then multiplied by 1.062 to capture the percentage of people who use the beach without buying a beach tag. Lastly, 30% is subtracted from the number to account for inclement weather. For Atlantic City, which does not sell beach tags, the number was taken from city estimates. The total number of visitor days for beaches within the project area are estimated at 14,816,000.

Benefits were not found to accrue from increased capacity because crowding was found not to be a significant factor. However benefits do arise from an increase in the value of the recreational experience.

Benefits resulting from this increase in recreational experience were calculated by multiplying $0.47 by the number of visitors days within the project area or 14,815,000. This gives total recreational benefits of $6,963,000. A breakdown of benefits for each community are as follows:

Community	Visitor Days	Day Value	Total Value
Atlantic City	9,800,000	$0.47	$4,606,000
Margate	2,093,000	$0.47	$983,710
Ventnor	2,267,000	$0.47	$1,065,490
Longport	655,000	$0.47	$307,850
Total	14,815,000	$0.47	$6,963,050

FINAL NED PLAN

ANNUALIZED COSTS

Table 16 displays the calculations for interest during construction. The duration of construction for the project is estimated at nineteen months. It is assumed the construction costs would be evenly distributed over the nineteen month period. First costs, nourishment costs, and major rehabilitation costs (year 24) are annualized and presented in Table 17, and operation, maintenance and monitoring (OM&M) costs are in Table 18.

Table 16

ABSECON ISLAND INTEREST DURING CONSTRUCTION			
Discount Rate:		7.625%	
Use Date:		Apr-1999	
Start Date:		Nov-2000	
MONTH	Monthly Costs	Interest Factor	Total Cost
1	$3,948,409	1.123386	$4,435,589
2	$2,677,659	1.116528	$2,989,682
3	$2,677,659	1.109712	$2,971,431
4	$2,677,659	1.102937	$2,953,290
5	$2,677,659	1.096204	$2,935,261
6	$2,677,659	1.089512	$2,917,342
7	$2,677,659	1.082861	$2,899,532
8	$2,677,659	1.076250	$2,881,830
9	$2,677,659	1.069680	$2,864,237
10	$2,677,659	1.063149	$2,846,752
11	$2,677,659	1.056659	$2,829,373
12	$2,677,659	1.050208	$2,812,100
13	$2,677,659	1.043797	$2,794,932
14	$2,677,659	1.037425	$2,777,870
15	$2,677,659	1.031091	$2,760,911
16	$2,677,659	1.024797	$2,744,056
17	$2,677,659	1.018540	$2,727,304
18	$2,677,659	1.012322	$2,710,654
19	$2,677,659	1.006142	$2,694,106
Total First Cost:	$52,146,300		
	Total Investment Cost:		$55,546,300
	Minus First Cost:		52,146,300
	Interest During Construction:		$3,400,000

Table 17

ABSECON ISLAND
BEACHFILL & NOURISHMENT
PRESENT WORTH ANALYSIS

Base Year:	2001		Discount Rate:	7.625%
Type	Year	Cost	PW Factor	PW Cost
Initial Cost	0	52,038,300	1.000000	52,038,300
Real Estate	0	108,000	1.000000	108,000
IDC	0	3,400,000	1.000000	3,400,000
Periodic Nourishment	3	12,187,595	0.802159	9,776,390
Periodic Nourishment	6	12,187,595	0.643459	7,842,220
Periodic Nourishment	9	12,187,595	0.516157	6,290,708
Periodic Nourishment	12	12,187,595	0.414040	5,046,149
Periodic Nourishment	15	12,187,595	0.332126	4,047,814
Periodic Nourishment	18	12,187,595	0.266418	3,246,991
Periodic Nourishment	21	12,187,595	0.213709	2,604,603
Periodic Nourishment	24	17,372,450	0.171429	2,978,140
Periodic Nourishment	27	12,187,595	0.137513	1,675,956
Periodic Nourishment	30	12,187,595	0.110308	1,344,383
Periodic Nourishment	33	12,187,595	0.088484	1,078,409
Periodic Nourishment	36	12,187,595	0.070978	865,056
Periodic Nourishment	39	12,187,595	0.056936	693,912
Periodic Nourishment	42	12,187,595	0.045672	556,628
Periodic Nourishment	45	12,187,595	0.036636	446,504
Periodic Nourishment	48	12,187,595	0.029388	358,167
			TOTAL	104,398,331
Capital Recovery Factor (50 Years @ 7.625%):				0.078235
AVERAGE ANNUAL COSTS:				**$8,167,600**

Table 18

MONITORING COSTS

PRESENT WORTH COST ANALYSIS

Base Year: 2001

Discount Rate: 7.625%

Type	Year	Cost	PW Factor	PW Cost
OM&M	0	0	1.000000	0
OM&M	1	284,000	0.929152	263,879
OM&M	2	251,000	0.863324	216,694
OM&M	3	284,000	0.802159	227,813
OM&M	4	251,000	0.745328	187,077
OM&M	5	284,000	0.692523	196,677
OM&M	6	251,000	0.643459	161,508
OM&M	7	284,000	0.597872	169,796
OM&M	8	251,000	0.555514	139,434
OM&M	9	284,000	0.516157	146,588
OM&M	10	251,000	0.479588	120,377
OM&M	11	284,000	0.445610	126,553
OM&M	12	251,000	0.414040	103,924
OM&M	13	284,000	0.384706	109,256
OM&M	14	251,000	0.357450	89,720
OM&M	15	284,000	0.332126	94,324
OM&M	16	251,000	0.308595	77,457
OM&M	17	284,000	0.286732	81,432
OM&M	18	251,000	0.266418	66,871
OM&M	19	284,000	0.247543	70,302
OM&M	20	251,000	0.230005	57,731
OM&M	21	284,000	0.213709	60,693
OM&M	22	251,000	0.198569	49,841
OM&M	23	284,000	0.184500	52,398
OM&M	24	251,000	0.171429	43,029
OM&M	25	284,000	0.159284	45,237
OM&M	26	251,000	0.147999	37,148
OM&M	27	284,000	0.137513	39,054
OM&M	28	251,000	0.127771	32,070
OM&M	29	284,000	0.118718	33,716
OM&M	30	251,000	0.110308	27,687
OM&M	31	284,000	0.102492	29,108
OM&M	32	251,000	0.095231	23,903
OM&M	33	284,000	0.088484	25,130
OM&M	34	251,000	0.082215	20,636
OM&M	35	284,000	0.076390	21,695
OM&M	36	251,000	0.070978	17,816
OM&M	37	284,000	0.065950	18,730
OM&M	38	251,000	0.061277	15,381
OM&M	39	284,000	0.056936	16,170
OM&M	40	251,000	0.052902	13,278
OM&M	41	284,000	0.049154	13,960
OM&M	42	251,000	0.045672	11,464
OM&M	43	284,000	0.042436	12,052
OM&M	44	251,000	0.039429	9,897
OM&M	45	284,000	0.036636	10,405
OM&M	46	251,000	0.034040	8,544
OM&M	47	284,000	0.031629	8,983
OM&M	48	251,000	0.029388	7,376
OM&M	49	284,000	0.027306	7,755
OM&M	50	0	0.025371	0
			TOTAL	$3,420,567
			Capital Recovery Factor (50 Years @ 7.625%):	0.078235
			AVERAGE ANNUAL OM&M COSTS:	$267,600

BENEFITS DURING CONSTRUCTION

The NED project will be constructed over nineteen months with an additional month before and after construction for mobilization and demobilization. Significant portions of the beach will be fully nourished before the project is completed in its entirety. The portions of the beach nourished early in the construction phase will provide storm damage reduction benefits. Table 19 displays the monthly benefits during construction and the average annual benefits this adds to the overall benefits.

Table 19

ABSECON ISLAND BENEFITS DURING CONSTRUCTION				
	Discount Rate:		0.07625	
	Use Date:		Apr-1999	
	Start Date:		Nov-2000	
Month	Work	Monthly Benefit	Interest Factor	Total Benefit
1	Mob.	0	1.123386	0
7	Atlantic City	400,106	1.082861	433,259
8	Atlantic City	400,106	1.076250	430,614
9	Atlantic City	400,106	1.069680	427,985
10	Atlantic City	400,106	1.063149	425,372
11	Atlantic City	400,106	1.056659	422,776
12	Atlantic City	400,106	1.050208	420,195
13	Atlantic City	400,106	1.043797	417,629
14	Atlantic City	400,106	1.037425	415,080
15	Atlantic City	400,106	1.031091	412,546
16	Atlantic City	400,106	1.024797	410,027
17	Atlantic City	400,106	1.018540	407,524
18	Ventnor-Margate-Longport	742,628	1.012322	751,779
19	Demob	742,628	1.006142	747,189
	TOTAL	$5,886,422		$6,121,976
Capital Recovery Factor (50 Years @ 7.625%):				0.078235
Benefits During Construction:				$479,000

BENEFIT-COST RATIO

Total average annual benefits are displayed by category in Table 20, along with annualized costs (rounded), and the resulting benefit-cost ratio. The result is a benefit-cost ratio of 1.9 with $7,870,300 in net benefits.

Table 20
BENEFIT-COST COMPARISON FOR THE NED PLAN

Discount Rate:	7.625%
Project Life:	50 Years
Price Level:	Oct. 1995
Base Year:	2001
BENEFITS:	
Storm Damage Reduction	$8,912,000
Reduced Maintenance	2,000
Recreation	6,963,000
Benefits During Construction	479,000
Total Average Annual Benefits	$16,356,000
COSTS:	
Initial Construction & Real Estate Costs	$52,146,000
Interest During Construction	3,400,000
Periodic Nourishment (per cycle)	12,187,595
Average Annual Construction Costs	$8,167,600
Average Annual O&M and Monitoring Costs	318,100
Total Average Annual Costs (Rounded)	$8,485,700
Benefit-Cost Ratio	**1.9**
Net Benefits	**$7,870,300**
Residual Damages	**$3,535,000**

SENSITIVITY ANALYSIS

INTEREST RATE

Project benefits and costs were annualized at higher discount rates of 8% and 10%. The results are displayed below.

SENSITIVITY ANALYSES Discount Rate Change	
8% Discount rate:	
Average Annual Benefits:	
Storm Damage Reduction[3]	$8,914,000
Recreation	$6,963,000
Benefits During Construction	$501,400
Average Annual Benefits:	$16,378,400
Average Annual Costs[4]	$8,679,900
Benefit-Cost Ratio:	1.89
Net Benefits:	$7,698,500
10% Discount rate:	
Average Annual Benefits:	
Storm Damage Reduction	$8,914,000
Recreation	$6,963,000
Benefits During Construction	$624,800
Average Annual Benefits:	$16,501,800
Average Annual Costs:	$9,756,800
Benefit-Cost Ratio:	1.69
Net Benefits:	$6,745,000

---

[3] Includes reduced maintenance

[4] Includes operation, maintenance, and monitoring

REPLACEMENT COST VALUES

The NED plan was also rerun changing the structure and content replacement values +/- 10 percent. The results are displayed below.

SENSITIVITY ANALYSES Replacement Cost Value Change	
+10% Structure Replacement Cost:	
Average Annual Benefits:	
Storm Damage Reduction[3]	$9,622,000
Recreation	$6,963,000
Benefits During Construction	$479,000
Average Annual Benefits:	$17,064,000
Average Annual Costs[4]	$8,485,700
Benefit-Cost Ratio:	2.01
Net Benefits:	$8,578,300
-10% Structure Replacement Cost:	
Average Annual Benefits:	
Storm Damage Reduction	$8,344,000
Recreation	$6,963,000
Benefits During Construction	$479,000
Average Annual Benefits:	$15,786,000
Average Annual Costs:	$8,485,700
Benefit-Cost Ratio:	1.86
Net Benefits:	$7,300,300

---

[3] Includes reduced maintenance

[4] Includes operation, maintenance, and monitoring

DEPTH-DAMAGE CURVES

The NED plan was also rerun changing the inundation depth-damage +/- 10 percent. The results are displayed below.

SENSITIVITY ANALYSES Depth-Damage Curves Change	
Depth-Damage Curves +10%:	
Average Annual Benefits:	
Storm Damage Reduction[3]	**$9,338,000**
Recreation	**$6,963,000**
Benefits During Construction	**$479,000**
Average Annual Benefits:	**$16,780,000**
Average Annual Costs[4]	**$8,485,700**
Benefit-Cost Ratio:	**1.98**
Net Benefits:	**$8,294,300**
Depth-Damage Curves -10%:	
Average Annual Benefits:	
Storm Damage Reduction	**$8,508,000**
Recreation	**$6,963,000**
Benefits During Construction	**$479,000**
Average Annual Benefits:	**$15,950,000**
Average Annual Costs:	**$8,485,700**
Benefit-Cost Ratio:	**1.88**
Net Benefits:	**$7,464,300**

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[3] **Includes reduced maintenance**

[4] **Includes operation, maintenance, and monitoring**

REPORT ON FIVE SURVEYS FOR THE UNITED STATES ARMY CORPS OF ENGINEERS

ABSECON ISLAND AND SEVEN MILE ISLAND, NEW JERSEY: STONE HARBOR, AVALON, ATLANTIC CITY, LONGPORT, MARGATE, VENTNOR

SURVEYS OF BEACH USERS, BUSINESSES, AND HOMEOWNERS

The Forum for Policy Research and Public Service
Rutgers University, Camden

Data Analysis and Report: Ross Koppel, Ph.D.

November, 1994

In the summer of 1994, The Forum for Policy Research and Public Service of Rutgers University (Camden) administered three surveys to samples of beach users, of businesses and of homeowners in the New Jersey communities of Stone Harbor, Avalon, Atlantic City, Longport, Margate, Ventnor.

The surveys examine respondents' valuations of the beach, the desired characteristics and facilities of a beach, the perceived impact of the beach on properties and businesses, and a variety of demographic measures.

Survey Administration:

The beach user survey was administered to a random sample of over one thousand people. Interviewers were trained to visually segment the beach into strata starting at the ocean. Strata were sampled according to their density (number of people). In addition, interviewers were trained to seek representative weightings of gender, age, and group size. Review of demographic data, of the beach use pattern data (distance from ocean and distribution of people) and of interviewer codes reveals no significant systematic skew or bias.

The homeowner survey was at first administered face-to-face. The process was laborious because so many residents were not at home (i.e., we met renters instead of owners, or homeowners were in their a non-shore house, at work, or on the beach). In consultation with the Corps, it was decided that we would use telephone interviews.

The business survey was generally administered face-to-face. At off-peak hours, business managers and owners are usually "in" and available.

Pretesting

Each of the research instruments was pretested on its target population. Each survey went through several iterations. Fortunately, because the populations were large, we were able to modify the questionnaires and retest them on new respondents. Each iteration of the three main questionnaires (beach users, homeowners, and businesses) were pretested on samples of 25 to 55 people. As with our other surveys, the sample presented here does not incorporate any of the responses from the pretest questionnaire.

Role of the Corps

We would like to thank the members of the Economics and Social Analysis Branch of the U.S. Army Corps of Engineers (Philadelphia District) for their help in developing the research instruments. They provided several examples of questionnaires used by earlier researchers in addition to useful background papers and methodological guides from previous researchers and from Corps documents. They also maintained a willingness to consider our efforts at survey improvement or enhancement. We appreciated their reviews of the many versions of each of the interview schedules that were eventually approved and administered. More important, we also appreciated their suggestionsand refinements to each document.

Training, Supervision and Additional Research

The interviewers were initially trained by Dr. Ross Koppel. Mr. Stephen Kucharski supervised the interviewers, coordinated their work, and provided additional training. Mr. Kucharski was also responsible for the SPSS data formatting, for supervising data entry, and for collection of additional data from State, Federal and local sources.

Structure of This Report

I. In the first section, we analyze the responses to the Beach Users Survey from respondents at the six communities on Absecon and Seven Mile Island (N = 1063).

Frequency distributions and crosstabulations of every item by several key variables have been calculated and are found in the appendix. They are also presented on disk. The following is a list of the crosstabulations we have calculated. Every variable is crosstabulated by:

Weather (Sunny vs. All Other)
Density of Beach Use (Categories 1 and 2 ["Light Use"] vs. 3, 4, 5 ["Full or More Crowded"])
Community location (Stone Harbor, Avalon, Atlantic City, Longport, Margate, Ventnor)
Yearly Visit Pattern (Visit Every Year; Most or Some Years; First Visit)
Days On Beach (Few -- 1-14; Many -- 15-30; Most -- 31-98)
Own or Rent Property at Shore

Year of Purchase [for owners] ("New" 1985-1994; "Old" 1900 to 1984)
Resident Status (Permanent; Staying for at least a week; Staying less than a week)
Income (Less than $49,999; $50,000 and over)
Education (High School or less vs. Some College or more)
Age (categorized in two formats because the age breakdowns for residents is skewed sharply to the right -- they tend to be over 60 years old)
  Age-1 (under 60 vs. 60 and older)
  Age-2 (under 40 vs. 40 and older)

As noted, the Appendix presents these crosstabulations for every question in the questionnaire. These data are also provided on disk in SPSS system files.

II. The second section presents the data from the interviews with Business Managers and Owners in the six towns in Absecon and Seven Mile Island. As with the previous findings, the appendix provides a range of crosstabulations in hard copy, and the accompanying disk files (SPSS system files) contain both the crosstabs and a full copy of the data.

The Survey of Businesses is a comparatively small sample (N =156). After review of the data, we have calculated and provide the following two crosstabulations (for every variable):

Business Schedule (Open all year vs. Open summer only)
No. of Employees (0-9 vs. 10-125)

III. The Survey of Homeowners is comprised of two samples:

1. a survey of homeowners from face-to-face interviews and via telephone interviews with residents; and

2. the subset of beach users who owned homes in the shore communities. (This latter group received a separate battery of questions from within the beach users' survey.)

Wherever possible and logical, we combine results from the two instruments. The sample size of the direct survey of homeowners is 251; the sample size of homeowners who were interviewed on the beach is 370. The combined sample size is 621. As with all the data, an SPSS file on disk is also provided.

The following crosstabulations were calculated for the homeowners' data:

Age (under 60 vs. 60 and older)
Education (High School or less vs. Some College or more)
Year of Purchase ("New" 1985-1994; "Old" 1900 to 1984)
Number of Blocks from Beach (1 or less vs more than 1)
Length of Stay (Permanent Resident vs. other)

IV. In the fourth section we use the beach valuation data from the surveys of beach users, businesses and homeowners to calculate a combined valuation figure for the beach and its impact on the communities.

V. The survey of Brigantine Beach users comprises the fifth section. This survey is somewhat shorter than the general beach users survey and addresses issues requested by the Corps. Many of the questions, however, are identical to those used in the other questionnaires.

The sample size is 255, and SPSS files on disk are provided.

VI. A complete copy of all questionnaires is included in section VI.

The Beach Users Survey
The Business Owners/Managers Survey
The Homeowners Survey
The Brigantine Beach Users Survey

Appendix 1 (Book "A") -- Frequency Distributions of:
1.1. The Beach Users Survey
1.2. The Business Owners/Managers Survey
1.3. The Homeowners Survey
1.4. The Brigantine Beach Users Survey

Appendix 2 -- Cross Tabulations (See full listing below)

Appendix 3 -- Digital: SPSS files of all data

APPENDIX TABLE SETS: CROSSTABULATION OF SURVEY DATA

BEACH USERS

APPENDIX
BOOK NO.

1 LOCATION (SIX COMMUNITIES' BEACHES) BY ALL OTHER VARIABLES

1 SHORE VISITING PATTERNS BY ALL OTHER VARIABLES
Recoded: Every year (1); Most or some years (2,3); First visit (4)

2 BEACH USER DENSITY BY ALL OTHER VARIABLES
Recoded: Few (1,2) vs. Crowded

2 WEATHER BY ALL OTHER VARIABLES
Recoded: Sunny (1) vs. All other (2,3,4)

2 DAYS SPENT ON THE BEACH BY ALL OTHER VARIABLES
Recoded: Few (1 to 14); Many (15 to 30); Most (31 to 98)

3 OWN HOME V. RENT BY ALL OTHER VARIABLES

3 YEAR OF HOME PURCHASE BY ALL OTHER VARIABLES
Recoded: "New" -- 1985 to 1994; "Old" -- 1900 to 1984
[for homeowners only]

3 RESIDENT STATUS BY ALL OTHER VARIABLES
Recoded: Permanent (1); All Summer to More than a week (2 to 5); Few days (6,7)

4 EDUCATION BY ALL OTHER VARIABLES
Recoded: High School or less (1,2,3,4) vs. Some College or more (5,6,7)

4 INCOME BY ALL OTHER VARIABLES
Recoded: Income: Less than $49,999 (1); $50,000 and over

5 AGE BY ALL OTHER VARIABLES
Recoded in two formats:

Age-1: under 60 vs. 60 and older

Age-2: under 40 vs. 40 and older

BUSINESS OWNERS AND MANAGERS

6 BUSINESS SCHEDULE BY ALL OTHER VARIABLES
Open all year vs. Open summer only

6 NUMBER OF EMPLOYEES BY ALL OTHER VARIABLES
Recoded: Few (0 to 9) vs. Many (10 to 125)

HOMEOWNERS

7 AGE BY ALL OTHER VARIABLES
Recoded: under 60. vs 60 and older

7 LENGTH OF STAY BY ALL OTHER VARIABLES
Recoded: Permanent Resident vs. All other categories

7 EDUCATION BY ALL OTHER VARIABLES
Recoded: High School or less (1,2,3,4) vs. Some College or more (5,6,7)

7 YEAR OF HOME PURCHASE BY ALL OTHER VARIABLES
Recoded: "New" -- 1985 to 1994;
"Old" -- 1900 to 1984

7 DISTANCE FROM BEACH (No. of Blocks) BY ALL OTHER VARIABLES
Recoded: One or less vs. More than one

I. SURVEY OF BEACH USERS

ON ABSECON ISLAND AND SEVEN MILE ISLAND, NEW JERSEY: STONE HARBOR, AVALON, ATLANTIC CITY, LONGPORT, MARGATE, VENTNOR

Introduction

The analysis in this section generally follows the survey instrument. All of the substantive items in the survey are reviewed except a few concerning homeowners, which are fully discussed inSection III, in the review of homeowner data.

Administration of the Interviews

Month

The Survey was conducted during the summer of 1994. Over two-thirds of the interviews were administered in July. See Table 1.

Table 1
MONTH OF THE INTERVIEW

			Valid	Cum	
Value Label	Value	Frequency		Percent	Percent
JUNE	6	133	12.5	12.5	12.5
JULY	7	731	68.8	68.8	81.3
AUGUST	8	182	17.1	17.1	98.4
SEPTEMBER	9	17	1.6	1.6	100.0
	Total	1063	100.0	100.0	

Valid cases 1063 Missing cases 0

Day of Week

Intentionally, each day of the week was not equally represented in the sample. That is, if each day of the week were to account for exactly one-seventh of the sample, then the weekend would reflect 28.57% of the sample. Our sampling of the week, however, seeks to reflect the actual beach usage patterns. Thus, as can be seen in Table 2, the weekend accounts for 36.4% of the sample, rather than 28.57% of the sample.

Table 2
DAY OF THE WEEK

Value Label	Value	Frequency		Valid Percent	Cum Percent
SUNDAY	1	159	15.0	15.0	15.0
MONDAY	2	61	5.7	5.7	20.7
TUESDAY	3	97	9.1	9.1	29.8
WEDNESDAY	4	205	19.3	19.3	49.1
THURSDAY	5	141	13.3	13.3	62.4
FRIDAY	6	172	16.2	16.2	78.6
SATURDAY	7	228	21.4	21.4	100.0
	Total	1063	100.0	100.0	

Time of Interview

Our earliest interview occurred at 09:45; our last interview was at 18:05. Most of the interviews were conducted in the afternoon. A full listing of the interview times is found in the Appendix.

Air Temperature

The median and modal temperature was 85 degrees Fahrenheit. Ninety-eight percent of the days were between 70 and 90 degrees Fahrenheit. (See Appendix for full listing.)

Water Temperature

The median water temperature was 65 degrees Fahrenheit. The low was 54 degrees F, the high was 75 degrees F. Note that the interviewers were instructed to request both air and water temperature readings from the life guards. They were not always exact.

Wind Speed

The median wind speed was 4.5 mph. The low was 0, the high was 15. Undoubtedly, there were days with higher wind speeds. But the beach tends to be less populated at such times. Note that as with temperature readings, the interviewers were also instructed to ask the life guards about wind speeds.

Weather

Almost three-fifths (59.6%) of the sample was collected during sunny weather; and about a quarter (23.8%) was collected on partly cloudy days. Our sampling focus, of course, was beach users, who tend to be on the beach in better weather. (See Table 3.)

Table 3
TYPE OF DAY

```
                                    Valid    Cum
Value Label      Value Frequency Percent Percent

SUNNY               1     634    59.6    59.6    59.6
PARTLY CLOUDY       2     253    23.8    23.8    83.4
CLOUDY              3     149    14.0    14.0    97.5
RAINY               4      27     2.5     2.5   100.0
                       ------- ------- -------
                Total    1063   100.0   100.0
```

Density of People on the Beach

We used a density measure developed for this study in cooperation with the Corps. As seen in Table 4, the beaches were seldom very crowded (about 7% of the time). Our scale and findings are:

Table 4

	Frq	Pct
1. PEOPLE SCATTERED ABOUT BEACH, BEACH MOSTLY EMPTY:	148	13.9
2. ON AVERAGE, SEVERAL YARDS BETWEEN TOWELS/BLANKET:	518	48.7
3. ON AVERAGE, SEVERAL FEET BETWEEN TOWELS/BLANKETS:	317	29.8
4. ON AVERAGE, DENSE, ONLY A FOOT OR TWO BETWEEN TOWELS/BLANKETS:	54	5.1
5. ON AVERAGE, VERY DENSE, LITTLE ROOM TO WALK:	26	2.4
Totals	1063	100.0%

Distribution of People on the Beach

The distribution of beach users reflects a standard bell shape. Table 5 displays the figures.

Table 5

		Frq	Pct
WATER:	1. MOST AT WATER; REST DISTRIBUTED EQUALLY:	41	3.9
	2. MOST AT WATER; REST TENDING UP BEACH:	12	1.1
	3. MOST AT WATER; REST TENDING MID BEACH:	287	27.0
EQUAL:	4. EQUALLY DISTRIBUTED: UP, MID AND WATERSIDE:	452	42.5
MID:	5. MOST IN MIDDLE; REST EQUALLY DISTRIBUTED:	140	13.2
	6. MOST IN MIDDLE; REST TENDING WATERSIDE:	92	8.7
	7. MOST IN MIDDLE; REST TENDING UP BEACH:	12	1.1
UP:	8. MOST UP BEACH; REST EQUALLY DISTRIBUTED:	9	.8
	9. MOST UP BEACH; REST TENDING TO MIDDLE:	14	1.3
	10. MOST UP BEACH; REST TENDING TO WATERSIDE:	4	.4
	Totals	1063	100.0%

Location: Communities

The communities of Stone Harbor and Avalon (Seven Mile Island) are reflected with samples of 293 and 250, respectively. Thus, the island is "represented" via a combined sample of 543 -- or 51% of our total sample. Absecon Island encompasses the communities of Atlantic City, Longport, Margate, and Ventnor. The samples are: 125, 132, 126, and 137, respectively -- or 49% of our total sample.

Table 6 indicates the information in conventional format.

Table 6
LOCATION OF BEACH

Value Label	Value	Frequency		Valid Percent	Cum Percent
STONE HARBOR	1	293	27.6	27.6	27.6
AVALON	2	250	23.5	23.5	51.1
ATLANTIC CITY	3	125	11.8	11.8	62.8
LONGPORT	4	132	12.4	12.4	75.3
MARGATE	5	126	11.9	11.9	87.1
VENTNOR	6	137	12.9	12.9	100.0
	Total	1063	100.0	100.0	

SUBSTANTIVE FINDINGS

Visiting Patterns: Yearly Visits

Over three-quarters of the beach users (76.2%) visit the shore every year. Only 2.5% report that it was their first visit.

Table 7
DO YOU VISIT NEW JERSEY BEACHES?

Value Label	Value	Frequency		Valid Percent	Cum Percent
EVERY YEAR	1	810	76.2	76.2	76.2
MOST YEARS	2	123	11.6	11.6	87.8
SOME YEARS	3	102	9.6	9.6	97.4
FIRST VISIT	4	27	2.5	2.5	99.9
	40	1	.1	.1	100.0
	Total	1063	100.0	100.0	

Days Spent on Beach

The median number of days on the beach during the summer is 18. The minimum is one (presumably, the day of the interview) and the maximum for the "season" is 98. The median, not surprisingly, however, may be deceptive. The data show the expected "lumpiness" of vacation schedules. About one-third spend between 7 and 15 days on the beach. 16% spend less than 7 days on the beach. An additional 10% spend over 70 days on the beach.

The reader must keep in mind that the respondents are trying to calculate both their schedules and probable good "beach days" -- See Appendix Table for full distribution.

Residence at the Shore

We asked respondents if they owned a home or rented a property at the shore. About two-thirds (67.5%) owned or rented. Of those with some type of residence at the shore, 51.7% (370) are owners, and 48.3% (346) are renters.

Number of people in Beach Outing

We asked respondents how many people usually accompanied them to the beach. (The question read: "On the average, including yourself, how many people typically go to the beach with you?") Less than 7% went alone, about one-fifth went with one other person (a party of two), another fifth went with two other people, and another fifth went with three other people. The median number was three. Less than 9% went with more than five people (party of six).

Table 8
NUMBER OF PEOPLE GO TO BEACH WITH

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1	71	6.7	6.7	6.7
	2	236	22.2	22.3	29.0
	3	227	21.4	21.4	50.4
	4	216	20.3	20.4	70.8
	5	121	11.4	11.4	82.2
	6	70	6.6	6.6	88.9
	7	25	2.4	2.4	91.2
	8	24	2.3	2.3	93.5
	9	7	.7	.7	94.1
	10-15	46	4.3	4.3	98.5
	16-50	16	1.5	1.5	100.0
	-1	4	.4	Missing	
	Total	1063	100.0	100.0	

Which Beach?

Almost nine-tenths (87.8%) of the respondents told us the usual beach they visited was the beach on which we conducted the interview. Most of the remaining 12.2% visited nearby New Jersey beaches. Less than 2% listed non-New Jersey beaches.

Table of "other" beaches in Appendix

Beach Tags

Our pretest sensitized us to the number of people who avoid purchasing beach tags. We therefore asked the questions about beach tags in two parts:

To the question: "Do you usually have to buy a beach tag to use this beach? 85.1% responded

"Yes" and 14.9% responded "No."

Table 9
DO YOU USUALLY HAVE TO BUY A BEACH TAG?

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
YES	1	904	85.0	85.1	85.1
NO	2	158	14.9	14.9	100.0
	-1	1	.1	Missing	
	Total	1063	100.0	100.0	

"If yes: We asked, "Do you have a tag, and if so what kind is it?" We received the following:

Table 10
DO YOU HAVE A TAG, WHAT KIND?

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
SEASON	1	675	63.5	74.6	74.6
WEEK	2	150	14.1	16.6	91.2
WEEKEND	3	3	.3	.3	91.5
DAY	4	21	2.0	2.3	93.8
NO PAY/NO TAG	5	56	5.3	6.2	100.0
	.	158	14.9	Missing	
	Total	1063	100.0	100.0	

Note that 6.2% of the sample indicated they were "cheaters." Note also the high proportion of season and weekly pass holders. This is consistent with our other data on length of stay.

Desired Characteristics of a Beach

The next sixteen questions are within a battery of items on desired characteristics of a beach. Respondents were read the following statement:

"There are several reasons why you might choose to visit New Jersey's beaches. Please indicate how important each of the following reasons is to you?" The following answer codes were also read: 1-not at all important; 2-slightly important; 3-moderately important; 4-very important; 5-extremely important; 6- NA

The questions and results are presented below:

a. To be with a large number of people

This was generally not a prominent reason for coming to the beach. Less than 7% called it very important and only about 10% called it extremely important.

Table 11
TO BE WITH A LARGE NUMBER OF PEOPLE

Value Label	Value	Frequency	Valid Percent	Percent	Cum
NOT AT ALL IMPORTANT	1	515	48.4	48.4	48.4
SLIGHTLY IMPORTANT	2	160	15.1	15.1	63.5
MODERATELY IMPORTANT	3	201	18.9	18.9	82.4
VERY IMPORTANT	4	73	6.9	6.9	89.3
EXTREMELY IMPORTANT	5	108	10.2	10.2	99.4
NA	6	6	.6	.6	100.0
	Total	1063	100.0	100.0	

b. To experience the visual qualities of the beach scenery

Respondents report that this is a compelling reason. Over three-quarters said this was very important or extremely important.

Table 12
EXPERIENCE VISUAL QUALITIES OF BEACH?

Value Label	Value	Frequency	Percent	Valid Percent	Cum
NOT AT ALL IMPORTANT	1	31	2.9	2.9	2.9
SLIGHTLY IMPORTANT	2	35	3.3	3.3	6.2
MODERATELY IMPORTANT	3	191	18.0	18.0	24.2
VERY IMPORTANT	4	308	29.0	29.0	53.2
EXTREMELY IMPORTANT	5	498	46.8	46.8	
100.0					
	Total	1063	100.0	100.0	

c. To socialize with family, friends and others

This reason was of importance. Almost two-thirds called it very important or extremely important.

Table 13
SOCIALIZE WITH FAMILY, FRIENDS & OTHERS

Value Label	Value	Frequency	Percent	Valid Percent	Cum
NOT AT ALL IMPORTANT	1	82	7.7	7.7	7.7
SLIGHTLY IMPORTANT	2	67	6.3	6.3	14.0
MODERATELY IMPORTANT	3	228	21.4	21.5	35.5
VERY IMPORTANT	4	299	28.1	28.2	63.7
EXTREMELY IMPORTANT	5	383	36.0	36.1	99.8
NA	6	4	.4	.1	100.0
	Total	1063	100.0	100.0	

d. To relax

Relaxation emerges as a prime reason to visit the beach. Almost nine-tenths list this as very important or extremely important.

Table 14
TO RELAX

Value Label	Value	Frequency	Percent	Valid Percent	Cum
NOT AT ALL IMPORTANT	1	12	1.1	1.1	1.1
SLIGHTLY IMPORTANT	2	9	.8	.8	2.0
MODERATELY IMPORTANT	3	87	8.2	8.2	10.2
VERY IMPORTANT	4	180	16.9	16.9	27.1
EXTREMELY IMPORTANT	5	775	72.9	72.9	100.0
	Total	1063	100.0	100.0	

e. To participate in beach activities (swim, surf, etc)

About 30% are not interested in active beach activities. The remaining 70% divide somewhat equally in defining these activities as moderately- very- or extremely important.

Table 15
TO PARTICIPATE IN BEACH ACTIVITIES?

Value Label	Value	Frequency	Percent	Valid Percent	Cum
NOT AT ALL IMPORTANT	1	195	18.3	18.4	18.4
SLIGHTLY IMPORTANT	2	128	12.0	12.1	30.4
MODERATELY IMPORTANT	3	269	25.3	25.3	55.7
VERY IMPORTANT	4	233	21.9	21.9	77.7
EXTREMELY IMPORTANT	5	237	22.3	22.3	100.0
	-1	1	.1		Missing
	Total	1063	100.0	100.0	

f. To enjoy being alone

Solitude is "extremely" desired by a quarter of the sample, and very important to another fifth. Only 18% called solitude "not at all important."

Table 16
TO ENJOY BEING ALONE

Value Label	Value	Frequency	Percent	Valid Percent	Cum
NOT AT ALL IMPORTANT	1	192	18.1	18.1	18.1
SLIGHTLY IMPORTANT	2	120	11.3	11.3	29.4
MODERATELY IMPORTANT	3	292	27.5	27.5	56.8
VERY IMPORTANT	4	197	18.5	18.5	75.4
EXTREMELY IMPORTANT	5	257	24.2	24.2	99.5
NA	6	5	.5	.5	100.0
	Total	1063	100.0	100.0	

g. There is little or no cost to enjoy the beach

This is a major factor, noted by over three-quarters of the respondents.

Table 17
LITTLE OR NO COST TO ENJOY BEACH

Value Label	Value	Frequency	Percent	Valid Percent	Cum
NOT AT ALL IMPORTANT	1	154	14.5	14.5	14.5
SLIGHTLY IMPORTANT	2	110	10.3	10.3	24.8
MODERATELY IMPORTANT	3	264	24.8	24.8	49.7
VERY IMPORTANT	4	198	18.6	18.6	68.3
EXTREMELY IMPORTANT	5	328	30.9	30.9	99.2
NA	6	9	.8	.8	100.0
	Total	1063	100.0	100.0	

h. It is a wide enough beach to enjoy many activities

Almost 85% said a wide beach was important. Most claim it is very important or extremely important. (Note, this question is also addressed in the comparison photos of replenished beaches vs. non-replenished beaches. Note also that older persons tended not to want wider beaches because of the difficulty of walking across the sand.)

Table 19
IT BEACH WIDE ENOUGH BEACH TO ENJOY MANY ACTIVITIES

Value Label	Value	Frequency	Percent	Valid Percent	Cum
NOT AT ALL IMPORTANT	1	91	8.6	8.6	8.6
SLIGHTLY IMPORTANT	2	73	6.9	6.9	15.4
MODERATELY IMPORTANT	3	222	20.9	20.9	36.3
VERY IMPORTANT	4	299	28.1	28.1	64.4
EXTREMELY IMPORTANT	5	376	35.4	35.4	99.8
NA	6	2	.2	.2	100.0
Total		1063	100.0	100.0	

i. It is a nice family-oriented beach

More than 90% find this important. Over half say it is extremely important.

Table 20
IT IS A NICE FAMILY-ORIENTED BEACH

Value Label	Value	Frequency	Percent	Valid Percent	Cum
NOT AT ALL IMPORTANT	1	51	4.8	4.8	4.8
SLIGHTLY IMPORTANT	2	43	4.0	4.1	8.9
MODERATELY IMPORTANT	3	137	12.9	12.9	21.8
VERY IMPORTANT	4	274	25.8	25.8	47.6
EXTREMELY IMPORTANT	5	553	52.0	52.1	99.7
NA	6	3	.3	.3	100.0
	-1	2	.2	Missing	
	Total	1063	100.0	100.0	

j. It is well protected by lifeguards

Not surprisingly, protection by lifeguards is a major factor. Almost four-fifths call it very important or extremely important.

Table 21
IT IS WELL PROTECTED BY LIFE GUARDS

Value Label	Value	Frequency	Percent	Valid Percent	Cum
NOT AT ALL IMPORTANT	1	50	4.7	4.7	4.7
SLIGHTLY IMPORTANT	2	44	4.1	4.1	8.9
MODERATELY IMPORTANT	3	130	12.2	12.3	21.1
VERY IMPORTANT	4	218	20.5	20.5	41.7
EXTREMELY IMPORTANT	5	618	58.1	58.2	99.9
NA	6	1	.1	.1	100.0
	-1	2	.2	Missing	
	Total	1063	100.0	100.0	

k. It is well maintained

A well maintained beach is viewed as important as one protected by lifeguards. Over 96% call this factor important to extremely important.

Table 22
IT IS WELL MAINTAINED

Value Label	Value	Frequency	Percent	Valid Percent	Cum
NOT AT ALL IMPORTANT	1	21	2.0	2.0	2.0
SLIGHTLY IMPORTANT	2	19	1.8	1.8	3.8
MODERATELY IMPORTANT	3	111	10.4	10.4	14.2
VERY IMPORTANT	4	267	25.1	25.1	39.3
EXTREMELY IMPORTANT	5	645	60.7	60.7	100.0
	Total	1063	100.0	100.0	

l. There is good fishing

Fishing does not emerge as important to most of the sample. Less than 30% seem to care about this activity at the beach.

Table 23
THERE IS GOOD FISHING

Value Label	Value	Frequency	Percent	Valid Percent	Cum
NOT AT ALL IMPORTANT	1	620	58.3	58.3	58.3
SLIGHTLY IMPORTANT	2	129	12.1	12.1	70.5
MODERATELY IMPORTANT	3	137	12.9	12.9	83.3
VERY IMPORTANT	4	67	6.3	6.3	89.7
EXTREMELY IMPORTANT	5	78	7.3	7.3	97.0
NA	6	32	3.0	3.0	100.0
		-------	-------	-------	
	Total	1063	100.0	100.0	

m. It is close to where I am staying at the shore

Proximity is critical. Only 6% fail to call it important.

Table 24
IT IS CLOSE TO WHERE I AM STAYING

Value Label	Value	Frequency	Percent	Valid Percent	Cum
NOT AT ALL IMPORTANT	1	43	4.0	4.0	4.0
SLIGHTLY IMPORTANT	2	21	2.0	2.0	6.0
MODERATELY IMPORTANT	3	131	12.3	12.3	18.3
VERY IMPORTANT	4	270	25.4	25.4	43.7
EXTREMELY IMPORTANT	5	570	53.6	53.6	97.4
NA	6	27	2.5	2.5	99.9
	8	1	.1	.1	100.0
		-------	-------	-------	
	Total	1063	100.0	100.0	

n. It is close to my permanent residence

Proximity of the beach to permanent residence is significantly less important than proximity of the beach to a temporary shore location.

Table 25
IT IS CLOSE TO MY PERMANENT RESIDENCE

Value Label	Value	Frequency	Percent	Valid Percent	Cum
NOT AT ALL IMPORTANT	1	166	15.6	15.6	15.6
SLIGHTLY IMPORTANT	2	97	9.1	9.1	24.7
MODERATELY IMPORTANT	3	210	19.8	19.8	44.5
VERY IMPORTANT	4	222	20.9	20.9	65.4
EXTREMELY IMPORTANT	5	338	31.8	31.8	97.2
NA	6	30	2.8	2.8	100.0
		-------	-------	-------	
	Total	1063	100.0	100.0	

o. There is enough parking

Parking emerges as a central concern for many beach users. Three-fifths call it very important or extremely important. There is, also, understandably, at least a sixth of the sample who do not drive to the beach and for whom parking is irrelevant.

Table 26
THERE IS ENOUGH PARKING

Value Label	Value	Frequency	Percent	Valid Percent	Cum
NOT AT ALL IMPORTANT	1	166	15.6	15.6	15.6
SLIGHTLY IMPORTANT	2	75	7.1	7.1	22.7
MODERATELY IMPORTANT	3	192	18.1	18.1	40.7
VERY IMPORTANT	4	252	23.7	23.7	64.4
EXTREMELY IMPORTANT	5	364	34.2	34.2	98.7
NA	6	14	1.3	1.3	100.0
		-------	-------	-------	
	Total	1063	100.0	100.0	

p. There are adequate snack bars and shops

Because so many respondents have homes, rental units, or hotel rooms near the beach, the importance of snack bars and shops is often less critical than it would be to a more transient population. Nevertheless, less than 30% say it is "not important at all." It is possible that this question should be separated into two: one for snack bars or restaurants, and one for shops that sell non-food items.

Table 27
THERE ARE ADEQUATE SNACK BARS & SHOPS

Value Label	Value	Frequency	Percent	Valid Percent	Cum
NOT AT ALL IMPORTANT	1	312	29.4	29.4	29.4
SLIGHTLY IMPORTANT	2	141	13.3	13.3	42.6
MODERATELY IMPORTANT	3	239	22.5	22.5	65.1
VERY IMPORTANT	4	173	16.3	16.3	81.4
EXTREMELY IMPORTANT	5	196	18.4	18.4	99.8
NA	6	2	.2	.2	100.0
	Total	1063	100.0	100.0	

Note: The question about snack bars and shops is the last of the battery. The next group of questions comprise the first of the beach valuation series.

PERCEIVED VALUE OF THE BEACH

We employed the Corps' previously tested series of questions to elicit the respondents' perceived dollar value for a day at the beach. The introductory wording is:

> "The next questions will help us measure the value society places on beaches. We do this by asking about the dollar value of enjoyment for a day on the beach. These estimates reflect only personal values and will not influence beach fees. Beach fees are set by towns, our research is for the U.S. Army Corps of Engineers."

Then, the first question is:

> "Previous studies reveal that, on average, people would be willing to pay about $4.00 per

> day per person to use a beach in New Jersey. Do you feel that a day using a New Jersey beach would be worth $4.00 to each member of your household?"

If the respondent says "Yes," he/she is asked about higher figures (e.g., $5.00, $6.00, or more). If the respondent says "No," he/she is asked about $3.00, $2.00 or less. If the respondent indicates zero, he/she is asked:

> "Which of the following statements best describes the reasons for your response:
>
> Not enough information
> Did not want to place a dollar value
> Object to the way the question was presented
> That is what it is worth to me
> (Other)

Analysis of this series of questions requires combining the responses from all of the items within it. When we do that, we find that the mean perceived value is $5.04 -- for those with non-zero responses; and is $4.22 if those with zero responses are included. The frequency distribution (combining all questions in the series) is:

Table 28

Dollar Value Offered	Frequency
0	167
$.05-.50	30
1.00	83
1.50	1
2.00	220
3.00	129
4.00	114
5.00	129
6.00	84
7.00	7
8.00	6
10.00	49
12.50	1
15.00	3
20.00	3
25.00	2
100.00	1
300.00	1

Mean w/ zeros = $4.22; Mean without zeros = $5.04

Those not willing to pay any amount (the zero responses) indicated the following explanations:

Table 29
REASONS FOR NOT ANSWERING

	Pct of Total	Pct Answering This Question
Not enough information	.3%	1.8%
Did not want to place a dollar value	2.0	12.7
Object to the way the question was presented	.2	1.2
That is what it is worth to me	2.5	16.3
(Other, see below)	10.3	65.7
NA	84.8	2.4

Answers to the "other" category were (in order, from most frequent to least frequent):

	Pct of those answering this "other" category
Taxes should pay for beach	45%
Should be free/public land	21
It's natural; cost inappropriate	18
I'm a resident/land owner	7
I refuse	6
Other	3

Impact of Cost on Number of Visits

The next question was built on the final answer to the bidding process above. Respondents were asked:

If an entry fee of____ [the amount respondent indicated in above question] were charged, how would that affect the number of visits you would make to New Jersey's beaches?

More than now__ If more, how many more visits _____
Same as now __
Fewer than now. If fewer, how many fewer visits_____

Not surprisingly, very few respondents (1%) said "more than now." Most said "same as now" (74.1%); and 25% reported "fewer than now."

Of the 1% (10 people) who said "more than now," two people estimated they would make one more visit, two estimated they would make two more visits, and five estimated they would make five more visits.

Of the 25% who said "fewer than now," the median was 9.5 fewer visits. The "low" was one fewer visits, and the "high" was 78 fewer visits (See Table 30)

Table 30
IF FEWER, HOW MANY FEWER VISITS?

Value Label	Value	Frequency	Valid Percent	Percent	Cum
	1	5	.5	2.1	2.1
	2	21	2.0	8.6	10.7
	3	13	1.2	5.3	16.0
	4	7	.7	2.9	18.9
	5	38	3.6	15.6	34.6
	7	18	1.7	7.4	42.0
	8	2	.2	.8	42.8
	9	3	.3	1.2	44.0
	10	36	3.4	14.8	58.8
	11	3	.3	1.2	60.1
	12	7	.7	2.9	63.0
	13	2	.2	.8	63.8
	14	5	.5	2.1	65.8
	15	14	1.3	5.8	71.6
	16	2	.2	.8	72.4
	19	1	.1	.4	72.8
	20	18	1.7	7.4	80.2
	22	2	.2	.8	81.1
	25	5	.5	2.1	83.1
	28	1	.1	.4	83.5
	30	9	.8	3.7	87.2
	32	3	.3	1.2	88.5
	35	3	.3	1.2	89.7
	36	1	.1	.4	90.1
	37	1	.1	.4	90.5
	40	3	.3	1.2	91.8
	42	5	.5	2.1	93.8
	45	3	.3	1.2	95.1
	48	1	.1	.4	95.5
	49	6	.6	2.5	97.9
	50	1	.1	.4	98.4
	56	2	.2	.8	99.2
	68	1	.1	.4	99.6
	78	1	.1	.4	100.0
	.	820	77.1	Missing	
		-------	-------	-------	
	Total	1063	100.0	100.0	

Perceived Value of Wider Beaches: Response to Photo

The next group of questions seeks to ascertain the perceived value of wider beaches -- an obvious result of beach replenishment. Respondents are shown a photograph of a beach and of a wide beach. They are asked the following:

Interviewer: Show photographs of the two beaches -- "A" with sand replenishment; "B" without sand replenishment. Ask: This survey is part of a study to assess the costs and benefits associated with beach sand replenishment.

Would you be willing to pay: More __ Less __ The Same __ than [amount respondent stated in earlier beach valuation question] if the NJ beach you usually visit were widened like the beach in Photo B [Bottom Photo]?

If more, how much more than [amount stated in earlier question]

If less, how much less than [amount stated in earlier question]

About one-sixth of the sample (16%) were willing to pay more for a wider beach. A small fraction (3.4%) would pay less for a wider beach. And most (80.6%) would pay the same.

Some of these results are associated with the age distribution of the sample. Older people tend to view wide beaches as an obstacle rather than as a benefit. Also, the photograph supplied by the Corps appears to offer a comparison of two rather wide beaches. It is possible that respondents, unaware of the impact of erosion and winter storms, felt the beach without replenishment was sufficient for summeractivities.

Valuation of wider beach: Those willing to pay more suggested a median figure of $1.00 -- with a low of $.50 and a top value of $100.00. (See Table 30 for the distribution.) It must be remembered that the figures here are "added" to the valuations established earlier. In general, one could add the one dollar median to the average $5.04 valuation established above -- to arrive at a "total" average value of $6.04.

Table 30 presents the frequency distribution for the "additional" dollars.

Table 30
IF MORE, HOW MUCH MORE

Value Label	Value	Frequency	Percent	Valid Percent	Cum
	.00	1	.1	.6	.6
	.50	5	.5	3.0	3.6
	1.00	79	7.4	47.9	51.5
	1.50	3	.3	1.8	53.3
	2.00	44	4.1	26.7	80.0
	3.00	11	1.0	6.7	86.7
	4.00	2	.2	1.2	87.9
	5.00	12	1.1	7.3	95.2
	7.00	2	.2	1.2	96.4
	10.00	3	.3	1.8	98.2
	12.00	1	.1	.6	98.8
	50.00	1	.1	.6	99.4
	100.00	1	.1	.6	100.0
	.	898	84.5	Missing	
		-------	-------	-------	
	Total	1063	100.0	100.0	

Of the few people (under 3%) wishing to pay less for a wider beach, the median figure is also $1.00.

Conceptually, these people would like to subtract a dollar from their earlier valuation of a day at the beach. Note that the range varies from fifteen cents to $4.00.

Table 31
IF LESS, HOW MUCH LESS

Value Label	Value	Frequency	Percent	Valid Percent	Cum
	.00	1	.1	3.0	3.0
	.15	1	.1	3.0	6.1
	.25	1	.1	3.0	9.1
	.50	4	.4	12.1	21.2
	1.00	9	.8	27.3	48.5
	2.00	10	.9	30.3	78.8
	3.00	4	.4	12.1	90.9
	4.00	3	.3	9.1	100.0
	.	1030	96.9	Missing	
		-------	-------	-------	
	Total	1063	100.0	100.0	

A Wider Beach, Fees and the Number of Visits

This next question builds on the above question about the value of a wider beach. It was asked of those who indicated that they were willing to pay more (or, for a very few, who wanted to pay less) for wider beaches. The question reads:

If a beach fee of [the amount stated in the question above] were charged, how would that affect the number of visits you would make to New Jersey's beaches?
More than now__ If more, how many more visits _____
Same as now __
Fewer than now. If fewer, how many fewer visits_____

The first tier of responses indicate little change:

Table 32

	N.	Pct.	Adj. Pct.
MORE THAN NOW	4	.4	2.0
SAME AS NOW	153	14.4	77.7
FEWER THAN NOW	40	3.8	20.3
NOT APPLICABLE	866	81.5	--
		100.0	

Because the question only affects less than one-fifth (18.5%) of the sample, results should be approached with some caution.

The very few (three valid responses) who say "more than now" indicate that they would visit the beach one to ten "additional" times.

The 3.8% who say "less than now" indicate that they would visit the beach, on average, 4 fewer times each season. See Appendix for distribution.

Erosion and the Beach

The earlier group of questions concerned wider beaches. This next question addresses the issue of erosion and the role of the beach. The question reads:

> This next question is not about widening beaches, but about maintaining beaches -- stopping them from eroding away. How important is it to you that there be a beach here at all?

The responses indicate that almost all of the sample understand the role of the beach. Less than one percent call the beach not important, and three-quarters call it very- or extremely important (See Table 33).

Table 33
IMPORTANCE OF BEACH AT ALL?

Value Label	Value	Frequency	Valid Percent	Percent	Cum
NOT AT ALL IMPORTANT	1	10	.9	.9	.9
SLIGHTLY IMPORTANT	2	37	3.5	3.5	4.4
MODERATELY IMPORTANT	3	113	10.6	10.7	15.1
VERY IMPORTANT	4	224	21.1	21.1	36.2
EXTREMELY IMPORTANT	5	675	63.5	63.6	99.8
NA	6	1	.1	.1	100.0
	-1	3	.3	Missing	
	Total	1063	100.0	100.0	

We then asked if respondents would "stop coming to this area if it did not have a beach"? More than four-fifths (83%) said "yes, they would stop coming.

Establishing an Erosion Protection Fund

Some of the more interesting theoretic debates pertain to the perceived value of a common good, in this case a beach. The question reads:

> Imagine there were a fund established for New Jersey beach protection against erosion. If you were to make a voluntary once-a-year contribution to this fund, even if you did not use the beach, what would be the maximum yearly amount that you would be willing to give?
>
> Keep in mind that this contribution would be in addition to any daily fees that you might pay?

Less than one-fifth (18.6%) indicated that they would contribute nothing. Among those who would contribute some money, the median amount is $50. The range is from less than one dollar to $10,000. Most responses are between $10.00 and $200.00. See appendix for frequency distribution.

Table 34
REASONS FOR NOT CONTRIBUTING

Those who would not contribute (18.6%) suggested that:

	Pct of Total
They did not have enough information	4.2%
They did not want to place a dollar value	2.0
"Zero" was what it is worth to them	2.8

Or a range of reasons, of which the most common were:

Beach fees should pay	3%
Taxes should pay	5%
Other	1%

Cost of Trip to Beach

We asked respondents the perceived relative value of a trip to the beach. The question reads, "All in all, how expensive do you consider a trip to the beach"? Most respondents defined the beach as a very good buy. Table 35 reflects the responses:

Table 35
HOW COSTLY THINK TRIP TO BEACH?

Value Label	Value	Frequency	Valid Percent	Percent	Cum
VERY EXPENSIVE	1	31	2.9	2.9	2.9
SOMEWHAT EXPENSIVE	2	207	19.5	19.5	22.4
SOMEWHAT INEXPENSIVE	3	333	31.3	31.3	53.7
VERY INEXPENSIVE	4	492	46.3	46.3	100.0
	Total	1063	100.0	100.0	

DEMOGRAPHICS

The last set of questions are provided to evaluate the sample and allow crosstabulations. The data reflect a robust representation of the beach users.

Employment Status

Table 36
PRESENT EMPLOYMENT STATUS

Value Label	Value	Frequency	Valid Percent	Percent	Cum
EMPLOYED FULL TIME	1	624	58.7	58.7	58.7
EMPLOYED PART TIME	2	106	10.0	10.0	68.7
NOT EMPLOYED	3	27	2.5	2.5	71.2
RETIRED	4	119	11.2	11.2	82.4
FULL TIME HOMEMAKER	5	113	10.6	10.6	93.0
STUDENT	6	70	6.6	6.6	99.6
OTHER	7	4	.4	.4	100.0
	Total	1063	100.0	100.0	

OTHER (EMPLOYMENT STATUS)

	Frq	Pct
DISABILITY	1	.1%
SELF EMPLOYED	3	.3%

Marital Status

Almost two-thirds (65%) are married. Singles represented 34%.

Keep in mind that the interviewers were instructed to interview people who appeared to be 18 years old or older. (See the "age"question, below.)

Household Income, Before Taxes

Questions about income is one of the more delicate items in any survey. In our surveys, only 10% refused to answer. The data suggest that respondents were reasonably truthful. (The median response is $40,000 through $49,999; higher than the national median but not unexpected for vacationers who can rent or who own shore properties.

Table 37
WHICH BEST DESCRIBES TOTAL INCOME?

Value Label	Value	Frequency	Percent	Valid Percent	Cum
UNDER $10,000	1	54	5.1	5.6	5.6
$10,000 TO $19,999	2	45	4.2	4.7	10.4
$20,000 TO $29,999	3	84	7.9	8.8	19.1
$30,000 TO $39,999	4	128	12.0	13.4	32.5
$40,000 TO $49,999	5	169	15.9	17.7	50.2
$50,000 TO $74,999	6	183	17.2	19.1	69.4
$75,000 TO $99,999	7	127	11.9	13.3	82.6
$100,000 AND OVER	8	166	15.6	17.4	100.0
	-1	107	10.1	Missing	
	Total	1063	100.0	100.0	

Number of People in Household this Year

The median number of household members was between two and three.

Table 38
HOW MANY PEOPLE IN YOUR HOUSEHOLD?

Value Label	Value	Frequency	Valid Percent	Percent	Cum
NO. OF PEOPLE IN HOUSEHOLD	1	139	13.1	13.3	13.3
	2	318	29.9	30.4	43.7
	3	213	20.0	20.4	64.1
	4	215	20.2	20.6	84.6
	5	102	9.6	9.8	94.4
	6	32	3.0	3.1	97.4
	7	15	1.4	1.4	98.9
	8	5	.5	.5	99.3
	9	1	.1	.1	99.4
	10	4	.4	.4	99.8
	12	2	.2	.2	100.0
	-1	17	1.6	Missing	
	Total	1063	100.0	100.0	

Education

Over half the sample had at least some college.

Table 39
HOW MUCH EDUCATION HAVE YOU COMPLETED?

			Valid		Cum
Value Label	Value	Frequency	Percent	Percent	
NO SCHOOL	1	6	.6	.6	.6
GRADE SCHOOL (6 YRS)	2	8	.8	.8	1.3
SOME HIGH SCHOOL (7-11)	3	20	1.9	1.9	3.2
HIGH SCHOOL GRADUATE	4	201	18.9	18.9	22.1
SOME COLLEGE (13 TO 15)	5	311	29.3	29.3	51.5
COLLEGE GRADUATE (16)	6	330	31.0	31.1	82.6
POST GRADUATE (OVER 16)	7	185	17.4	17.4	100.0
	-1	2	.2	Missing	
	Total	1063	100.0	100.0	

Race/Ethnicity

The sample was overwhelmingly white. Whites represented 95.6% of the sample. African Americans represented only 1.9% of the sample, and Latinos comprised only 1%. While these ratios do not reflect the region, they do appear to approximate beach usage in the communities in which we conducted the research.

Table 40
DESCRIPTION OF RACIAL OR ETHNIC BACKGROUND

			Valid		Cum
Value Label	Value	Frequency	Percent	Percent	
WHITE OR CAUCASIAN	1	1015	95.5	95.6	95.6
BLACK/AFRICAN AMERICAN	2	20	1.9	1.9	97.5
LATINO	3	11	1.0	1.0	98.5
ASIAN	4	13	1.2	1.2	99.6
NATIVE AMERICAN	5	2	.2	.2	100.0
	-1	2	.2	Missing	
	Total	1063	100.0	100.0	

Age

The model category is age 30 to 39. Over half of the age distribution is under 39. (Compare this to the population of homeowners -- which is significantly older.)

Table 41
WHICH BEST DESCRIBES YOUR AGE GROUP?

Value Label	Value	Frequency	Percent	Valid Percent	Cum
10 TO 19	1	32	3.0	3.0	3.0
20 TO 29	2	237	22.3	22.4	25.4
30 TO 39	3	300	28.2	28.3	53.7
40 TO 49	4	236	22.2	22.3	75.9
50 TO 59	5	131	12.3	12.4	88.3
60 TO 69	6	95	8.9	9.0	97.3
70+	7	29	2.7	2.7	100.0
	.	3	.3	Missing	
	Total	1063	100.0	100.0	

Clarity Question

The last close-ended question asked about the wording in the our survey. Only 0.4% of the sample claimed that the wording was unclear.

Table 42
CLARITY: HOW DID YOU FIND THE WORDING?

Value Label	Value	Frequency	Percent	Valid Percent	Cum
VERY CLEAR	1	367	34.5	41.1	41.1
CLEAR	2	451	42.4	50.5	91.6
MODERATE	3	71	6.7	8.0	99.6
UNCLEAR	4	3	.3	.3	99.9
VERY UNCLEAR	5	1	.1	.1	100.0
	.	170	16.0	Missing	
	Total	1063	100.0	100.0	

General Comments

One-sixth of the respondents offered additional comments or suggestions regarding New Jersey's ocean beaches.

The major themes were:

-- Additional efforts should be made to clean up the beaches.
-- The beach fees are needed
-- The beach fees are resented
-- Beach replenishment is needed
-- Taxes should pay for beach replenishment

The appendix and the SPSS data disks contain a complete listing.

Crosstabulations

Crosstabulations of every item by several key variables have been calculated and are found in the appendix. Every variable iscrosstabulated by:

Weather (Sunny vs. All Other)
Density of Beach Use (Categories 1 and 2 ["Light Use"] vs. 3, 4, 5 ["Full or MoreCrowded"])
Community location (Atlantic City, Longport, Margate, Ventnor)
Yearly Visit Pattern (Visit Every Year; Most or Some Years; First Visit)
Days On Beach (Few -- 1-14; Many -- 15-30; Most -- 31-98)
Own or Rent Property at Shore
Year of Purchase [for owners] ("New" 1985-1994; "Old" 1900 to 1984)
Resident Status (Permanent; Staying for at least a week; Staying less than 8 days)
Income (Less than $49,999; $50,000 and over)
Education (High School or less vs. Some College or more)
Age (categorized in two formats because the age breakdowns for residents is skewed sharply to the right -- they tend to be over 60 years old)
    Age-1 (under 60 vs. 60 and older)
    Age-2 (under 40 vs. 40 and older)

II. SURVEY OF BUSINESSES

STONE HARBOR, AVALON,
ATLANTIC CITY, LONGPORT, MARGATE, AND VENTNOR

In appraising the value of a beach, previous research has generally focused on beach users. In our survey of shore businesses, we seek to extend the analysis to include this population (of business owners and managers) that also benefits from beaches and beach replenishment.

The Survey

The Survey was administered to 157 businesses in the six shore communities identified by the Corps -- Stone Harbor, Avalon, Atlantic City, Longport, Margate and Ventnor. The interviews were conducted in July and August of 1994.

Location

The location of the interviews (the distribution among the six communities) generally reflects the density of businesses in thevarying towns. Thus, for example, there are few business interviews in Longport, but a substantial number in Stone Harbor. Table 1 provides a breakdown of the locations:

Table 1
LOCATION OF INTERVIEW

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
Stone Harbor	1	38	24.2	24.4	24.4
Avalon	2	41	26.1	26.3	50.6
Atlantic City	3	24	15.3	15.4	66.0
Longport	4	5	3.2	3.2	69.2
Margate	5	24	15.3	15.4	84.6
Ventnor	6	24	15.3	15.4	100.0
	.	1	.6	Missing	
	Total	157	100.0	100.0	

Proximity to the Beach

Because proximity to the beach is usually desirable for a business and because we ask businesspersons about the value of the beach for their businesses, we recorded the number of blocks to the beach from each business property.

Four businesses (2.6%) were less than one bock from the beach; about a quarter (24.5%) were within one block. Most of the businesses (52.3%) were within two blocks of the beach. (See Table 2 for a full listing.)

Table 2
BLOCKS NUMBER OF BLOCKS TO THE BEACH

Value Label	Value	Frequency	Valid Percent	Percent	Cum
	0	4	2.5	2.6	2.6
	1	33	21.0	21.9	24.5
	2	42	26.8	27.8	52.3
	3	47	29.9	31.1	83.4
	4	16	10.2	10.6	94.0
	5	2	1.3	1.3	95.4
	6	1	.6	.7	96.0
	8	2	1.3	1.3	97.4
	10	1	.6	.7	98.0
	12	1	.6	.7	98.7
	20	1	.6	.7	99.3
	25	1	.6	.7	100.0
	.	6	3.8	Missing	
		-------	-------	-------	
	Total	157	100.0	100.0	

Type of Business

The sample consists of the expected range of retail establishments. The sample is:

Clothing, shoes, jewelry, tee shirts	16
Restaurants, bars, fast foods	15
Food Markets	6
Home repair and hardware	5
Hotel and motels	4
Hairdressers, nail shops	4
Realtors	3
Cleaners and tailors	3

ALSO: bait and tackle shop, art gallery, bank, bike store, camera shop, book store, tv repair (2), tv cable dealer, cab service, limo service, car rental agent, baby furniture, furniture (2), liquor store, yarn store, video stores (2), sports supplies (2), pest and bug removal, museum, library, insurance agents (2), law office, pottery shop, surf shop, and drug stores (2)..

Seasonal or Year-Round

Two-thirds of the businesses were open all year -- see Table 3.

Table 3
IS BUSINESS OPEN ALL YEAR OR ONLY DURING SUMMER

Value Label	Value	Frequency	Percent	Valid Percent	Cum
ALL YEAR	1	105	66.9	67.3	67.3
SUMMER SEASON	2	51	32.5	32.7	100.0
	.	1	.6	Missing	
	Total	157	100.0	100.0	

Valid cases 156 Missing cases 1

SUBSTANTIVE FINDINGS

Role of Beach

Our first substantive question asked businesspersons to estimate the percentage of customers who were at the shore because of the beach.

The businesspeople recognize the overwhelming role of the beach to their economic existence. The median estimate was that three-quarters of the customers were "due" to the beach. A third of the sample indicated that between 90% to 100% of the customers were attributable to the presence of the beach. Table 4 presents a complete listing. (See next page for Table 4.)

Table 4
WHAT PERCENTAGE OF YOUR CUSTOMERS AT SHORE BECAUSE OF BEACH

Value Label	Value	Frequency	Valid Percent	Percent	Cum
PERCENT OF CUSTOMERS "DUE" TO BEACH	0	1	.6	.7	.7
	1	1	.6	.7	1.3
	4	1	.6	.7	2.0
	5	3	1.9	2.0	3.9
	8	1	.6	.7	4.6
	10	7	4.5	4.6	9.2
	15	1	.6	.7	9.8
	20	9	5.7	5.9	15.7
	25	6	3.8	3.9	19.6
	30	5	3.2	3.3	22.9
	35	2	1.3	1.3	24.2
	40	2	1.3	1.3	25.5
	50	17	10.8	11.1	36.6
	55	1	.6	.7	37.3
	60	2	1.3	1.3	38.6
	65	2	1.3	1.3	39.9
	70	7	4.5	4.6	44.4
	75	11	7.0	7.2	51.6
	80	14	8.9	9.2	60.8
	85	5	3.2	3.3	64.1
	90	23	14.6	15.0	79.1
	95	11	7.0	7.2	86.3
	98	2	1.3	1.3	87.6
	99	2	1.3	1.3	88.9
	100	17	10.8	11.1	100.0
	-1	4	2.5	Missing	
	Total	157	100.0	100.0	

Valid cases 153 Missing cases 4

Impact of Erosion

The next question addresses the perceived impact of beach erosion on business income. The question reads:

If the beach were to erode away completely, how would this affect your business? Would it lose:

1. a quarter of its income   2. a half of its income__
3. three-quarters of its income   4. almost all of its income__
5. all of its income   6. other

The results indicate that the question is almost too threatening to consider. Although the above question reveals that businesspersons are aware of the role of the beach in bringing customers, businesspeople are frequently less willing to examine the consequences of total erosion. Table 5 (frequencies) and Table 6 (responses within the "other" category) reveal the inconsistency. Only 4.5% insist that total erosion with have no affect. But at least one-fifth claim the impact of total beach erosion would be less than 25% of their business income. (Note that about half of the sample report that they would lose at least half of their business income if there were total erosion.)

Table 5
HOW WOULD EROSION AFFECT YOUR BUSINESS?

Value Label	Value	Frequency	Valid Percent	Percent	Cum
A QUARTER OF ITS INCOME	1	28	17.8	18.1	18.1
HALF OF ITS INCOME	2	33	21.0	21.3	39.4
THREE-QUARTERS OF ITS INCOME	3	26	16.6	16.8	56.1
ALMOST ALL OF ITS INCOME	4	25	15.9	16.1	72.3
ALL OF ITS INCOME	5	17	10.8	11.0	83.2
OTHER	6	26	16.6	16.8	100.0
	-1	2	1.2	Missing	
Total			100.0	100.0	

Table 6
"OTHER" RESPONSE TO HOW EROSION AFFECTS BUSINESS

Value Label	Value	Frequency	Valid Percent	Percent	Cum
		134	85.4	85.4	85.4
LOSS PERCENTAGE	10%	2	1.3	1.3	86.6
	15%	2	1.3	1.3	87.9
	2/3	1	.6	.6	88.5
	20%	1	.6	.6	89.2

5%	2	1.3	1.3	90.4
60%	1	.6	.6	91.1
80%	1	.6	.6	91.7
90%	1	.6	.6	92.4
DON'T KNOW	1	.6	.6	93.0
NOT SPECIFIED	2	1.3	1.3	94.3
NO AFFECT	7	4.5	4.5	98.7
UNCERTAIN	2	1.3	1.3	100.0
	-------	-------	-------	
Total	157	100.0	100.0	

Business and the Existence of a Beach

The next question is a follow-up item. It reads: "How important is it to your business that there be a beach here at all?" The results are in line with the earlier question. While over three-quarters call it very- to extremely important, a fifth are less sure.

Table 7
HOW IMPORTANT IS IT TO YOUR BUSINESS THAT THERE BE A BEACH AT ALL

Value Label	Value	Frequency	Valid Percent	Percent	Cum
NOT AT ALL IMPORTANT	1	9	5.7	5.8	5.8
SLIGHTLY IMPORTANT	2	8	5.1	5.1	10.9
MODERATELY IMPORTANT	3	16	10.2	10.3	21.2
VERY IMPORTANT	4	36	22.9	23.1	44.2
EXTREMELY IMPORTANT	5	87	55.4	55.8	100.0
	.	1	.6	Missing	
		-------	-------	-------	
	Total	157	100.0	100.0	

Taxes and Replenishment

Beliefs about tax allocations may influence respondents attitudes toward beach replenishment. We wanted to know if businesspersons believed that local taxes are used in any federal/U.S. Army Corps of Engineer projects. The question reads:

> "Do you know if any of the local taxes go toward replacing the sand lost to storms or waves?" Yes Think so No

The results suggest that most believe that their local taxes are not directed toward beach replenishment. See Table 8

Table 8
DO YOU KNOW IF ANY OF THE LOCAL TAXES GO TO BEACH REPLENISHMENT

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
yes	1	24	15.3	15.4	15.4
think so	2	24	15.3	15.4	30.8
no	3	108	68.8	69.2	100.0
	.	1	.6	Missing	
	Total	157	100.0	100.0	

The reader is cautioned, however, that the question is potentially flawed. It is not absolutely clear how to interpret the responses. "No," for example, could mean that the respondent does not know if local taxes are used for beach replenishment, or "no" could mean he/she does not believe that local taxes are used for beach replenishment.

The pattern of the data suggest that we may be overly cautious. Given the distribution of "think so" vs. "no," it appears that "no" probably does mean "no." Nevertheless, it is important to maintain some doubt.

Paying More Taxes For a Wider Beach

In a format similar to that used with the beach users' study, we contrasted photographs of a beach with sand replenishment with one without send replenishment.

One-quarter (25.3%) reported that they would be willing to pay more taxes for a wider beach. (And three-quarters said they did not want to pay increased taxes for a wider beach.)

Table 9
WOULD YOU PAY MORE TAXES FOR WIDER BEACH

Value Label	Value	Frequency	Percent	Valid Percent	Cum
more	1	39	24.8	25.3	25.3
no	2	115	73.2	74.7	100.0
	.	3	1.9	Missing	
	Total	157	100.0	100.0	

Valid cases 154 Missing cases 3

Those who reported they were willing to pay more taxes were asked "how much more."

The "additional" taxes ranged from 1% to 200%. The median increase is 9%. (See Table 10 next page.)

IF MORE, HOW MUCH MORE? Table 10

Value Label	Value	Frequency	Percent	Valid Percent	Cum
PERCENTAGE INCREASE	1.00	1	.6	4.5	4.5
	2.00	4	2.5	18.2	22.7
	5.00	2	1.3	9.1	31.8
	8.00	1	.6	4.5	36.4
	10.00	6	3.8	27.3	63.6
	17.00	1	.6	4.5	68.2
	20.00	3	1.9	13.6	81.8
	25.00	3	1.9	13.6	95.5
	200.00	1	.6	4.5	100.0
	.	135	86.0	Missing	
	Total	157	100.0	100.0	

(No respondents indicated how much less they would like to give.)

An Annual Fund for Erosion Protection

As with the beach users survey, we also asked businesspersons if they would contribute to a fund for N.J. beach erosion protection.

Almost a third (29.2%) offered no additional funds -- the .00 in Table 11. The range of non-zero responses was from $5.00/yr to $10,000/yr. The median of all responses (i.e., with zeros included) is approximately $75/yr. The median of all positive responses is approximately $175/yr.

Table 11
YEARLY CONTRIBUTION TO A GENERAL FUND

Value Label	Value	Frequency	Valid Percent	Percent	Cum
	.00	35	22.3	29.2	29.2
	5.00	1	.6	.8	30.0
	10.00	1	.6	.8	30.8
	25.00	5	3.2	4.2	35.0
	50.00	8	5.1	6.7	41.7
	100.00	37	23.6	30.8	72.5
	150.00	2	1.3	1.7	74.2
	200.00	11	7.0	9.2	83.3
	250.00	1	.6	.8	84.2

300.00	1	.6	.8	85.0
500.00	6	3.8	5.0	90.0
750.00	1	.6	.8	90.8
1000.00	9	5.7	7.5	98.3
1500.00	1	.6	.8	99.2
10000.00	1	.6	.8	100.0
-1.00	37	23.5	Missing	
	-------	-------	-------	
Total	157	100.0	100.0	

SAMPLE CHARACTERISTICS

Age of Business

The median age of businesses in our sample was 10 years. The minimum was under one year (first season/year), and the longest running business was 100 years. Table 11 displays the distribution.

Table 11
HOW OLD IS BUSINESS?

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
YEARS IN BUSINESS	0	1	.6	.6	.6
	1	6	3.8	3.9	4.5
	2	4	2.5	2.6	7.1
	3	9	5.7	5.8	12.9
	4	10	6.4	6.5	19.4
	5	10	6.4	6.5	25.8
	6	9	5.7	5.8	31.6
	7	10	6.4	6.5	38.1
	8	6	3.8	3.9	41.9
	9	4	2.5	2.6	44.5
	10	12	7.6	7.7	52.3
	11	4	2.5	2.6	54.8
	12	6	3.8	3.9	58.7
	13	2	1.3	1.3	60.0
	14	2	1.3	1.3	61.3
	15	4	2.5	2.6	63.9
	16	1	.6	.6	64.5
	17	4	2.5	2.6	67.1
	18	3	1.9	1.9	69.0
	20	5	3.2	3.2	72.3

22	3	1.9	1.9	74.2
23	2	1.3	1.3	75.5
24	2	1.3	1.3	76.8
25	2	1.3	1.3	78.1
26	2	1.3	1.3	79.4
27	1	.6	.6	80.0
28	2	1.3	1.3	81.3
30	8	5.1	5.2	86.5
36	1	.6	.6	87.1
38	2	1.3	1.3	88.4
40	5	3.2	3.2	91.6
45	2	1.3	1.3	92.9
49	1	.6	.6	93.5
50	6	3.8	3.9	97.4
60	1	.6	.6	98.1
70	1	.6	.6	98.7
73	1	.6	.6	99.4
100	1	.6	.6	100.0
-1	2	1.2	Missing	
	-------	-------	-------	
Total	157	100.0	100.0	

Number of Employees

The businesses ranged in size from no employees (just owner) to 125 employees. The median was 5 employees -- about half had fewer employees and half had more than 5 employees.

Table 12
HOW MANY PEOPLE EMPLOYED AT THIS BUSINESS

Value Label	Value	Frequency		Valid Percent	Cum Percent
NUMBER OF EMPLOYEES	0	1	.6	.7	.7
	1	13	8.3	8.6	9.3
	2	15	9.6	9.9	19.2
	3	15	9.6	9.9	29.1
	4	17	10.9	11.3	40.4
	5	17	10.9	11.3	51.7
	6	10	6.4	6.6	58.3
	7	6	3.8	4.0	62.3
	8	8	5.1	5.3	67.5
	9	3	1.9	2.0	69.5

```
   10     4    2.6    2.6   72.2
   11     1     .6     .7   72.8
   12     6    3.8    4.0   76.8
   13     1     .6     .7   77.5
   14     2    1.3    1.3   78.8
   15     8    5.1    5.3   84.1
   20     1     .6     .7   84.8
   23     1     .6     .7   85.4
   25     7    4.5    4.6   90.1
   26     1     .6     .7   90.7
   28     2    1.3    1.3   92.1
   30     5    3.2    3.3   95.4
   35     1     .6     .7   96.0
   40     3    1.9    2.0   98.0
   50     1     .6     .7   98.7
   60     1     .6     .7   99.3
  125     1     .6     .7  100.0
   -1     5    3.2  Missing
        ------- ------- -------
 Total      156   100.0   100.0

Valid cases    151    Missing cases     5
```

Education Level of Manager/Owner

Most owners or managers had some college or more schooling. Less than a quarter had a high school education or fewer years of education.

HOW MUCH EDUCATION HAVE YOU COMPLETED?

Value Label	Value	Frequency	Percent	Valid Percent	Cum
GRADE SCHOOL	2	2	1.3	1.3	1.3
SOME HIGH SCHOOL	3	6	3.8	3.9	5.2
HIGH SCHOOL GRADUATE	4	30	19.1	19.6	24.8
SOME COLLEGE	5	46	29.3	30.1	54.9
COLLEGE GRADUATE	6	64	40.8	41.8	96.7
POST GRADUATE	7	5	3.2	3.3	100.0
	-1	4	2.2	Missing	
		-------	-------	-------	
	Total	157	100.0	100.0	

Valid cases 153 Missing cases 4

In the appendix, are crosstabulations of every variable in the businesspersons survey by the following two variables:

Business Schedule (Open all year vs. Open summer only)

No. of Employees (0-9 vs. 10-125)

III. SURVEY OF HOMEOWNERS

We interviewed 251 homeowners in the six shore communities on Absecon and Seven Mile Island. The questionnaire focused on the perceived affects of beach erosion on property values, on perceived tax allocations, on use of the beaches, and on perceptions of sand replenishment efforts.

The primary sample for the homeowners study is comprised of respondents we interviewed in their homes in face-to-face interviews and via phone interviews (N = 251). A second sample is comprised of homeowners we interviewed as part of the beach users survey, i.e., beach users who owned homes in the nearby communities. In the beach user questionnaire we included a series of questions that are identical to questions in the homeowners' survey (N = 370). We present the combined results below.

The Surveys: Comparing the Samples

One task is to compare the two samples -- to contrast the similarities and differences so that the combined results can be better understood.

The 251 homeowners were interviewed in the summer of 1994, the same time as the beach user survey. While there are some systematic differences between the two samples, the similarities predominate. The major difference appears to be age: homeowners interviewed at their homes are, on average, older than homeowners interviewed on the beach.

Because few readers are interested in the methodological concerns of comparing samples, our discussion of the similarities and differences of the two samples is found at the end of this section -- after the review of the substantive findings. The specific data comparing the two samples on demographic and other characteristics are presented in that methodological subsection, in Tables M1 to M11.

FINDINGS

The Cost of Erosion

Our first substantive question seeks to ascertain the homeowners' perceived cost of erosion. The question reads:

> If the beach were to erode away completely, how would this affect the value of your property? Would it lose:
>
> a quarter of its value__ a half of its value__

three-quarters of its value__ almost all of its value__
all of its value__ other

The samples are very consistent. Both homeowners interviewed at their homes (hereafter homeowners) and homeowners interviewed on the beach (hereafter homeowners o-t-b) reported that their properties would lose much of the value in the event of total beach erosion. Review of Table 1 reveals that approximately two-thirds of both samples say their homes would lose at least 75% of the value.

Table 1
HOW WOULD VALUE OF HOUSE CHANGE

	Homeowners	Homeowners O-T-B
	percent	percent
A QUARTER OF ITS VALUE	22.1	25.8
A HALF OF ITS VALUE	5.6	11.1
3/4 OF ITS VALUE	32.1	32.8
ALL OF ITS VALUE	12.9	15.3
ALMOST ALL OF ITS VALUE	4.8	4.2
OTHER	22.5	10.8
	(N=251)	(N=370)

Summary of "Other" Category (Percentages for total samples):

	percent	percent
ABOUT HALF TO THREE-QUARTERS	5.0	3.0
NO AFFECT	7.0	5.0
NO IDEA	9.0	3.0

Allocation of Taxes

We asked respondents if any of their local taxes are allocated toward replacing the sand lost to storms or waves. About three-fifths of the homeowners (both samples) indicated that local taxes were not allocated to beach replenishment. Another quarter said the "think so."

Table 2
TAXES TO REPLENISHMENT?

	Homeowner percent	Homeowner O-T-B percent
YES	17.2	12.8
THINK SO	26.4	26.0
NO	56.4	61.1

Note: As discussed in the first section, the reader is cautioned that the wording of this question is potentially ambiguous. It is possible that respondents are not telling us about the allocation of taxes, but rather about their familiarity with the allocation process.

Taxes/Payments for a Wider Beach

In a question format similar to that discussed in the first section, we asked respondents if they would be willing to pay more taxes for wider beaches.

Less than one-fifth (in either sample) felt that wider beaches were worth the cost of additional taxes or payments. Table 3 presents the results for both the homeowners and the homeowners o-t-b. The similarity in the responses is striking.

Table 3
PAY MORE TAXES/PAYMENTS FOR WIDER BEACH

	Homeowner percent	Homeowner O-T-B percent
WILLING TO PAY MORE	17.5	17.5
NOT WILLING TO PAY MORE	81.2	79.9
WILLING TO PAY LESS	1.3	3.1

Those willing to pay more, were asked "how much more?"

It is difficult to compare the two samples because the follow-up questions were asked somewhat differently for each of the samples. For the homeowners, the question was direct (e.g., "how much more"). But for the homeowners o-t-b, the question was related to an earlier valuation question; respondents were essentially asked "how much more than you were willing to spend in [an earlier question]". Equally significant, the homeowner sample was asked the question in terms of additional taxes, whereas the homeowner o-t-b sample were asked the question in terms of additional payments. (In later economic analysis, we disaggregate the two groups.)

Table 4
"ADDITIONAL" TAXES/PAYMENT FOR WIDER BEACH

	Homeowner percent	Homeowner O-T-B percent
Minimum	0.1%	$0.50
Maximum	200.0%	$100.00
Median	10.0%	$6.72

Keeping Beaches Where They Are

Our next item switches focus to ask not about widening the beach, but rather about the danger of serious erosion. The question reads:

> This next question is not about widening beaches, but about maintaining beaches -- stopping them from eroding away. How important is it to you that there be a beach here at all?
>
> 1-not at all important; 2-slightly important; 3-moderately important; 4-very important; 5-extremely important; 6- NA]

Again, the results for both samples are consistent. Almost four-fifths call it "extremely important." Under 3% call it not important.

Table 5
IMPORTANCE OF BEACH AT ALL?

	Homeowner percent	Homeowner O-T-B percent
NOT AT ALL IMPORTANT	2.4	.3
SLIGHTLY IMPORTANT	.8	.3
MODERATELY IMPORTANT	4.8	2.4
VERY IMPORTANT	23.5	16.7
EXTREMELY IMPORTANT	68.1	79.8
NA	.4	--

Fund Against N.J. Beach Erosion

The last substantive question we examined asks respondents if they would contribute to a general fund for beach protection. The question reads:

> Imagine there were a fund established for New Jersey beach protection against erosion. If you were to make a voluntary once-a-year contribution to this fund, even if you did not use the beach, what would be the maximum yearly amount that you would be willing to give?
>
> Keep in mind that this contribution would be in addition to any taxes and daily fees that you might pay?

The results of this question reflects some divergence between the samples. One possible cause of the differences is the questionnaire structure and length. Given the different contexts, however, we are impressed with the similarities. These are open-ended questions; no guides are offered, and the respondents knew that the questions were hypothetical.

The median offered to the "fund" is $25 to $46.00. The maximum (in each case offered by one person) is $10,000.00 to $20,000.00. The typical high offer is $100 to $300.00. (The full distributions are in the appendix tables.)

Table 6
GIVE MONEY TO A FUND FOR N.J. BEACHES

	Homeowner percent	Homeowner O-T-B percent
Minimum	0.00	0.00
Percent offering $0.00	42.2%	19.4%
Maximum	$20,000.00	$10,100.00
Median with zero offers included	$25.00	$46.00
Median with only non-zero offers included	$380.00	$79.00

Non-Contributors

We asked those who refused to give dollar values why they refused. The responses are:

Table 7
WHAT STATEMENT DESCRIBES YOUR REASON FOR NOT CONTRIBUTING

	Homeowner percent	Homeowner O-T-B percent
NOT ENOUGH INFORMATION	11.6	4.2
NOT WANT TO PLACE $ VALUE	5.2	1.4
OBJECT TO PRESENTATION	.4	0.0
WHAT IT'S WORTH TO ME	6.0	.7
OTHER	22.7	12.7

Reasons in the "other" category include: "can't afford more," "taxes should cover the cost," and "businesses should pay."

Summary

As seen in the previous surveys, homeowners in both samples appear to appreciate the importance of erosion and the need for beach replenishment. While they may not want (nor want to pay for) wider beaches, they certainly do not wish to see the water any closer to their homes than it is currently.

In general, the similarity of the responses between the two samples is striking.

COMPARING THE SAMPLES: HOMEOWNERS AND HOMEOWNERS ON THE BEACH

The data below are provided for those who wish to contrast the two samples.

Age

As noted, homeowners interviewed in their homes were generally older than the homeowners interviewed on the beaches. See Table M1.

Table M1

AGE	Homeowner Percent	Homeowner O-T-B Percent
10 to 19	3.3	3.0
20 to 29	4.1	14.1
30 to 39	11.0	20.9
40 to 49	16.7	26.4
50 to 59	17.9	16.8
60 to 69	25.6	14.7
70+	21.5	4.7
	(N = 251)	(N = 370)

Homeowners interviewed at home (column on the left) were generally more elderly (and near elderly), i.e., 60 - 69 and those 70 or older.

Visiting Patterns

The homeowners interviewed in their homes and the homeowners interviewed on the beaches (o-t-b) had almost identical visitingpatterns.

Table M2

HOW OFTEN DO YOU COME TO NJ BEACHES?

	Homeowner percent	Homeowner o-t-b percent
EVERY YEAR	95.2	96.7
MOST YEARS	.4	2.7
SOME YEARS	1.6	0.0
FIRST YEAR HERE	0.0	0.5

Days on the Beach

Not all of the homeowners interviewed in their homes visited the beach; 16.8% never went to the beach. In contrast, and by definition, all of the homeowners we interviewed on the beach spent at least one day on the beach. Thus, there is some basic difference in the two samples. On the other hand, if you compare the median days on the beach of the two samples for those who visit the beach at least once, they are very close: 38 days vs. 39 days (see Table M3).

Table M3

MEDIAN NUMBER OF DAYS ON THE BEACH

	Med. no. of days
Homeowners who go to beach	38
Homeowners interviewed on the beach	39

(The median for homeowners interviewed in their homes, when including the 16.8% who never visit the beach, is 22 days.)

Period of Time Spent at the Shore

We asked respondents about the portion of the summer they spent at their N.J. shore residences. Results, overall, are somewhat similar for the two groups. Those interviewed on the beach are less likely (by 5%) to be permanent residents, and are less likely to spend the entire summer at the shore.

Table M4
HOW LONG ARE YOU STAYING AT THE SHORE

	Homeowner percent	Homeowner O-T-B percent
PERMANENT RESIDENT	45.6	40.3
HERE ALL SUMMER, ALL	43.2	34.4
WEEKENDS, ALL SUMMER	4.0	17.4
HERE FOR TWO WEEKS	6.4	4.5
HERE FOR ONE WEEK	.8	1.7
HERE FOR WEEKEND ONLY	--	.3
HERE FOR THE DAY ONLY	--	1.4

Buy House

We asked homeowners when they purchased their houses. The most recent were bought this summer. The least recent was 1900. The median year for home purchases by homeowners was 1978; The median purchase year for homeowners o-t-b was 1983. The difference is consistent with other patterns reflecting the older status of the homeowners interviewed in their homes.

We also asked them if the house was inherited or purchased. No noteworthy difference emerges.

Table M5
INHERITED OR BOUGHT

	Homeowner percent	Homeowner O-T-B percent
INHERITED	9.3%	11.5%
BOUGHT	90.7%	88.5%

Income and Race

The homeowners and homeowners o-t-b appear to be quite similar in income distribution (Table M6) and race/ethnicity (Table M7). The median income is $50,000 to $74,999. The sample is overwhelmingly white.

Table M6

INCOME	Homeowner percent	Homeowner O-T-B percent
UNDER $10,000	4.7	3.2
$10,000 TO $19,999	7.4	2.8
$20,000 TO $29,999	7.4	5.6
$30,000 TO $39,999	9.5	6.9
$40,000 TO $49,999	11.1	10.5
$50,000 TO $74,999	19.5	21.8
$75,000 TO $99,999	12.6	19.0
$100,000 AND OVER	27.2	30.2

Table M7

ETHNIC/RACIAL

	Homeowner percent	Homeowner O-T-B percent
WHITE	94.4	98.9
BLACK	3.9	.3
LATINO	.8	.5
NATIVE AMERICAN	.4	0

Education

Homeowners appear to have a higher percentage of post graduate degrees. Overall, however, the education distributions are similar.

Table M8

EDUCATION

	Homeowners percent	Homeowners O-T-B percent
GRADE SCHOOL (0-6)	.4	.3
SOME HIGH SCHOOL (7-11)	2.4	1.0
HIGH SCHOOL GRADUATE	25.1	1.7
SOME COLLEGE (13-15)	19.0	16.3
COLLEGE GRADUATE (16)	32.0	24.6
POST GRADUATE (16+)	20.6	32.9

Employment Status

Homeowners interviewed at their homes are more than twice as likely to be retired than those interviewed on the beach (44.6% vs. 19%). Correspondingly, those interviewed on the beach are more likely to be employed. These differences are obviously related to the age distribution.

Table M9

EMPLOYMENT STATUS	Homeowner percent	Homeowner O-T-B percent
EMPLOYED FULL TIME	27.6	52.6
EMPLOYED PART TIME	11.6	10.4
NOT EMPLOYED	2.0	4.2
RETIRED	44.6	19.0
FULL-TIME HOMEMAKER	10.4	9.7
STUDENT	3.8	3.8
OTHER	1.2	.3
DISABILITY	--	.3

Location

The samples differ somewhat in the proportions associated with each of the towns.

Table M10

LOCATION ON THE BEACH

	Homeowner percent	Homeowner O-T-B percent
STONE HARBOR	31.9	14.5
AVALON	33.9	20.8
ATLANTIC CITY	10.4	12.6
LONGPORT	17.9	9.7
MARGATE	1.6	23.5
VENTNOR	4.4	18.7

The differential is due to several factors:

1. Communities differ in the average age of their residents and the differing age groups had differential use rates for the beach.

2. Some beaches are more popular than others -- they have a net in-flow of residents from other towns.

3. We sampled homeowners on the beach with a different methodology than that used for contacting homeowners in their homes. The beach survey was designed to interview one-half of the sample on each of the two islands -- and it achieved that ratio.

4. Some communities have much higher ratios of homeowners than others during the summer.

Marital Status

About seven-tenths of both samples are married.

Table M11

MARRIED OR SINGLE

	Homeowner percent	Homeowner O-T-B percent
MARRIED	70.3	68.7
SINGLE	29.7	31.3

Number of People in Permanent Residence

Those interviewed in their homes tend to have slightly smaller households than homeowners interviewed on the beach. The median number of people in the household for homeowners (in homes) was 2;

The median number of people in the household for homeowners O-T-B was 2.7.

Comparison of Samples: Summary

While those interviewed at home are, on average, older and less likely to be in the labor force, many issues under analysis in this study -- homeownership and shore visiting patterns -- remain quite similar across a range of comparisons. The similarities include date of purchase, method of acquiring house (inherited or purchased), income, marital status, time spent at the shore, race/ethnicity.

OTHER REFERENCE DATA

Distance from the Beach

We recorded the location of each house in relation to the beach. Typically, wealthier homes are closer to the beach. Most homes were within two blocks of the beach.

A caution is noted, however, that these six communities are on barrier islands; they are typically only a few blocks wide (with some exceptional portions). Thus, the fact that most homes are not far from the beach should not be interpreted as an indication of great wealth.

Table M12

NUMBER OF BLOCKS TO THE BEACH? (Homeowner Survey Only)

Value Label	Value	Frequency	percent	Valid percent	Cum
	1	1	.4	.4	.4
	1	81	32.3	32.8	33.2
	2	88	35.1	35.6	68.8
	3	47	18.7	19.0	87.9
	4	13	5.2	5.3	93.1
	5	7	2.8	2.8	96.0
	6	3	1.2	1.2	97.2
	7	1	.4	.4	97.6
	10	4	1.6	1.6	99.2
	15	1	.4	.4	99.6
	20	1	.4	.4	100.0
	-1	4	1.6	Missing	
		-------	-------	------	
Total		251	100.0	100.0	

Total 251 100.0 100.0

Valid cases 244 Missing cases 7

IV. PERCEIVED VALUE AND DOLLARS

In the previous sections we presented the findings from our surveys on the beaches, in homes, and in businesses. In this section we try to link key survey findings on the individual's value of beaches to dollar estimates for the communities.

In this brief review we can only sketch some of the possible analyses. We hope these examples, however, help suggest some directions for economic use of the survey data.

BEACH USERS AND PERCEIVED VALUE OF A DAY AT THE BEACH

A series of questions in the beach user questionnaire engages the respondent in a process to determine the perceived value of a day at the beach. We derived two figures from that process:

1. The mean value of a day at the beach based on all beach users, including those who provided a "zero" value. The mean was $4.22

2. The mean value of a day at the beach based on all beach users who provided values greater than "zero" -- those who indicated a positive value. This mean was $5.04

Which measure to use? Once a perceived value of a day at the beach is determined, the next step is to multiply that value by the number of beach users. But which measure is more appropriate? Those with zero values, or only those with positive values? We argue that the best measure is the lower figure ($4.22) because it incorporates in it the 16% of beach users who assign a zero value in the bidding process. That is, it already reflects those who might have to be "subtracted" from the higher mean of $5.04. Thus, the more conservative figure will be used in the next step.

Important Note on Beach Tags and Beach Fees: Much of the previous research incorporating this valuation procedure did not involve beaches with beach tags or beach fees. It is most probable that without a beach tag fee we would have derived a higher valuation for a day at the beach (and fewer respondents suggesting a zero contribution). Thus, users of these data are urged to consider the downward impact of these beach fees. Five of the six beaches we surveyed had beach tags/beach fees.

Number of Beach Users: Data on the number of beach users at six communities are derived from the several tourism boards and chambers of commerce. For five of our communities, the best usage figures are obtained from the sale of beach tags. Atlantic City, which is the only community without beach tags, reports what it insists are reliable estimates of beach usage.

To derive a common denominator for the data, we convert each of the beach tag sales figures to daily estimates. Thus, weekly tags are multiplied by 7 (days), and season tags are multiplied by 98 (days).

Estimate of Beach Days for Beach Tag Communities

Community	Season Tags	Weekly Tags
Margate	28,400	4,699
Ventnor	28,985	29,900
Stone Harbor	22,700	11,100
Avalon	41,961	17,160
Longport	8,883	1,490
Subtotal	130,929	64,349

To derive the total number of days:

130,929 X 98 = 12,831,042

64,349 X 7 = 450,443

Subtotal 13,281,485

To this we correct by the average number of beach tag cheaters (6.2%) ascertained in the beach users survey (see Table 10, Section I).

13,281,485 x 106.2% = 14,104,937 beach user days.

Atlantic City: To the above figure we must add the beach user figures from Atlantic City, the one community without beach tags. Atlantic City informs us that the average daily number of beach users is 100,000. Multiplied by the 98 days in the official season = 9,800,000 beach user days.

(Note that there is no "cheater" correction for the Atlantic City data because there are no beach tags.)

Combining the two figures yields: 23,904,937 beach user days.

The final product: Multiplying the number of beach user days by the mean value of a beach day ($4.22) generates a figure of $100,878,834.00. That is, the beach users' valuation of the beach is almost $101 million each season. Moreover, this figure only reflects the "official" season The beach is used much more than the 98 days of our analysis. Also, the $101 million does not reflect the value of the beach for children, who do not buy beach tags. Arguably, many children value the beach more than many adults.

The Value of A Wider Beach

About one-sixth of the beach users (16%) were willing more to pay for a wider beach. (A few [3.4%] are willing to pay for a narrower beach.) Among those willing to pay for a wider beach, the median additional amount (added to perceived value of a day at the beach) was $1.00. Thus if beach widening were undertaken, one could conceivably add $1.00 for 16% of the beach user-days. (And subtract $1.00 for 3.4% of the beach user' valuations.)

The arithmetic of that calculation is straightforward:

To add money for a wider beach:
No. of beach user-days (from above): 23,904,937 X .16 = 3,824,789 X $1.00 = $3,824,789

To subtract money for an (unwanted) wider beach:
No. of beach user-days (from above): 23,904,937 X .034 = 812,768 X $1.00 = $812,786

The net gain:

$3,824,789 (more for a wider beach) less 812,786 (less for a wider beach)
Net value increase= $3,012,003 for a wider beach.

Note that although few want to pay taxes for wider beaches, the beach user survey reveals that almost all respondents say they want wide beaches.

A Special Fund for New Jersey Beach Erosion Protection

Over four-fifths (81.4%) of the respondents indicated they would contribute on an annual basis (beyond taxes) to a special fund for beach erosion protection, even if they did not use the beach. The median contribution offered was $50.00 (with a low of a few cents and a high of $10,000).

Because the question includes the phrase, "even if you did not use the beach," it is unclear which groups could be included (or excluded) in the analysis. All visitors to New Jersey? All Americans? If we take the $50 figure plus the 81.4% contribution rate as a guide to the number who would contribute, we can theoretically extrapolate to any known population. For example, New Jersey is fifth-ranked state in total tourism dollars. If 81.4% of tourists contributed $50.00 each, the resulting figure would be extraordinary. Alternately, one could limit the population to beach users in the state. Here, again, the dollar values would still be remarkable.

BUSINESSES AND THE VALUE OF THE BEACH

We have two questions/measures in the business survey that reflect the value of the beach to businesses.

The first asks the owners/managers to estimate the percentage of their customers who are in the area because of the beach. The median estimate is 75% of customers.

The second measure represents a different approach. It asks business owners/managers to estimate the affect on business income if the beach were to erode away. The result is very similar to the first: the median loss estimate is 75% of income.

Number of Businesses: The next obvious step is to determine the number of businesses in the 6 communities. This information was obtained from the six chambers of commerce and city offices. The data are:

Community	No. of Businesses
Atlantic City	2,940
Ventnor	627
Margate	539
Longport	215
Stone Harbor	672
Avalon	85
Total	5,078

Value of Business Receipts: U.S. Department of Commerce data indicate that the average retail business's receipts are $2,675,270 (Adjusted from Table 861, Statistical Abstract of the United States. U. S. Bureau of the Census. Washington, D.C. 1991). As a heuristic exercise, we assume that the average beach community business is taking in only one-quarter of that amount; thus the average receipts would be $668,817.

Continuing the example, and assuming that the 5,078 businesses take in the average receipts of $668,175., then the total value of receipts is $3,396,255,265.

If we accept the owners/managers' estimates of the value of the beach for their businesses equals 75%, then one way of deriving the value of the beach is to "earmark" 75% of the receipts:

.75 X $3,396,255,265 = $2,447,191,448.

That is, using a modest set of assumptions, and employing either of the survey-derived estimates of the beaches' importance to local businesses (erosion loss or customers draw), indicates that the value of the beach to businesses could be calculated at almost $2.5 billion. Further analysis would require obtaining business receipt data and/or business tax data.

More Taxes for a Wider Beach

As with beach users, business owners and managers were asked if they would be willing to pay more taxes for a wider beach. One quarter (25.3%) stated that they would be willing to pay more taxes for such enhancement. The median increase in taxes offered was 9%. (The minimum percentage increase was 1%, the maximum percentage increase was 200%.) Obviously, if one-quarter of all shore businesses were willing to pay 9% more in taxes for wider beaches, the impact would be considerable.

Again, further analysis would require obtaining business receipt data and/or business tax data.

A Special Fund for New Jersey Beach Erosion Protection:

As with beach users, business owners and managers were asked if they would be willing to contribute on an annual basis (beyond taxes) to a special fund for beach erosion protection, even if they did not use the beach. Seven-tenths of the businesses claimed they would contribute. The minimum offered was $5.00; the maximum offered was $10,000. The median contribution offered (of those 70% offering contributions) was approximately $175.00

Unlike the example of the beach users, we do know the number of businesses in the six communities. Multiplying the 5,078 businesses by the contribution ratio of 70% = 3,555. Multiplying 3,555 (number of businesses contributing) by the median contribution of $175.00

indicates that the total fund contribution is $622,125.

HOMEOWNERS AND THE VALUE OF THE BEACH

Much of the same methodology used in understanding the value of the beach for businesses can be employed with homeowners. That is, while homeowners do not have receipts, they did estimate the cost of erosion to the value of their homes, and they did indicate their willingness to support wider beaches and erosion prevention funds.

Cost of erosion

Each homeowner was asked to estimate the value of his/her property if the beaches were to suffer major erosion -- were to erode away completely. The median response was "three-quarters of its value." Below, we list the median value of homes and the number of homes in the six target communities.

Community	Median House Price	Total No. of Homes
Atlantic City	$73,400	13,453
Ventnor	137,700	6,645
Margate	176,800	7,904
Longport	201,800	3,300
Stone harbor	285,600	7,266
Avalon	285,700	1,474
	Total	40,042

Multiplying each community's median house price by the number of houses, and summing the figures yields a total home value of almost 6.5 billion dollars ($6,462,126,000).

If, based on the survey's median estimate, three-quarters of the value were to be lost due to total beach erosion, than the loss would equal over 4.8 billion dollars -- $4,846,594,500.

Taxes for a Wider Beach

Homeowners were also asked if they would be willing to pay more taxes for a wider beach. About a sixth (17.5%) indicated that they were willing to pay more taxes for such enhancement. The median of additional taxes offered was 10%. The minimum was 0.1% and the maximum was 200% additional taxes.

A Special Fund for New Jersey Beach Erosion Protection:

Last, homeowners were also asked if they would be willing to contribute on an annual basis to a special fund for beach erosion -- even if they did not directly benefit from it. Seven-tenths said they would contribute to such a fund. The median contribution for those offering a contribution was $229.50

If we do the math, the additional contributions to the fund are:

40,042 homes X .70 (contribution ratio) = 28,029 X $229.50 (themedian contribution) = $6,432,655. Thus, homeowners indicate that they would be willing to contribute an additional $6.4 million for a general fund against beach erosion.

Summary and Linking of Estimates

Many factors (e.g., employment and its multipliers, tourism expenditures, beach fees, and rental income) determine the value of the beach to a community or region. This report has focused on several measures obtained from our surveys. It is clearly beyond the scope of this report to ascertain exact dollar figures for the total value of the beach. We have, however, attempted to sketch some of the possible economic analyses and computations that can be based on the survey data and/or on the survey data in concert with other data.

Below, we combine the figures we have derived to provide partial estimates of the value of the beach -- estimates that would not be possible without the survey data:

Beach Users
The beach users' valuation of the beach (official season days only).................... $100,878,834

Net tax increase for a wider beach............ 3,012,003

Contributions to a beach erosion fund ($50 X 81.4% of sample) Specific value... undetermined

Businesses
Value of beach to businesses (percent of customers or loss if total erosion)...... 2,447,191,448

Businesses willing to pay more taxes for wider beach (25.3% of businesses @ median of 9% increase)...................................... undetermined

Businesses willing to contribute to a beach erosion fund.................................. 622,125

Homeowners
Cost of erosion to homeowners (their estimate of loss)...................................... 4,846,594,500
(Note: Unlike the other figures in this list, this number is not repeated annually.)

Homeowners willing to pay more for a wider beach.................................... undetermined

Homeowners willing to contribute to a beach erosion fund........................... 6,432,655

Total annual value = $2.659 billion
Total one-time value = $4.847 billion

The data indicate that the annual added value of the beach, based only on these survey estimates. is $2.659 billion.

This figure does not include any estimate of: beach users contributions to a beach erosion fund. additional taxes that businesses say they would pay for a wider beach; or additional taxes that homeowners say they are willing to pay for wider beaches. Note also that our calculations do not include the funds paid to the municipalities for beach fees. The undetermined monies could well dwarf the sums listed above.

Last, the $2.659 billion annual figure does not reflect the $4.8 billion that homeowners estimate as their loss to erosion.

Clearly the importance of the beach -- as perceived by its users and as estimated by businesses and homeowners -- is enormous. The data presented in this report should allow analysts to more fully and accurately estimate the true value of this resource.

5/26/94

NEW JERSEY BEACH USERS SURVEY
(ABSECON AND SEVEN MILE ISLANDS)

1. M__ __ D__ __ Y__ __ 2. Day of Wk (1-7) ____ 3. Tm __ __:__ __

4. Temp__ __ (F) 5. Water Temp__ __ (F) 6. Wind____ MPH 7. S, PC, C, R

8. Dens. (1-5) ___ 9. Distr.(1-10) ___ 10. Intvr: ___________________

11. Intvr. code number __ __ 12. Location: 1. Stone Harbor 2. Avalon
3. Atlantic City 4. Longport 5. Margate 6. Ventnor ___

INTRODUCTION: GOOD MORNING/AFTERNOON, I'M ____ FROM RUTGERS UNIVERSITY. THIS IS AN ANONYMOUS QUESTIONNAIRE ON BEACH EROSION AND THE IMPORTANCE OF BEACHES. THIS STUDY IS CONDUCTED BY RUTGERS UNIVERSITY FOR THE U.S. ARMY CORPS OF ENGINEERS AND THE NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION. IT WILL ONLY TAKE ABOUT 10 MINUTES.

13. Do you visit New Jersey beaches: **[Intvr: read choices]** Every year__
Most years__ Some years__ Or, is this your first visit here__

14. How many days do you estimate that you <u>will</u> spend on New Jersey beaches <u>this</u> summer, in total? (Beach visits only, do not count trips to the boardwalks, etc) ______

15. Do you own or rent a residence along the N.J. shore? Yes__ No__
[If no, skip to #17; Note: if lives with relatives at shore = yes]

16. **[If yes to #15]** Is that <u>own</u> or <u>rent</u>? Own__ Rent__ **[if "rent" skip to Quest. 17. Note also: if renting with several friends = rent]**

16a. In what town is your shore house?

16b. When did you buy your house? yr:______ (Inherit/fam.___)

16c. Do you know if any of the local taxes go toward replacing the sand lost to storms or waves? Yes__ Think so__ No___

16d. If the beach were to erode away completely, how would this affect the value of your property? **[INTV: if no immediate quantifiable answer, ask:]**
Would it lose:
a quarter of its value__ a half of its value__
three-quarters of its value__ almost all of its value__
all of its value__ other____________________________

17. For how long are you staying at the N.J. shore this summer:
[Intvr: read choices]
a. Permanent resident (all year)__
b. Here all summer, all week__
c. Here mostly on weekends, but all summer__
d. Here for two weeks__
e. Here for one week__
f. Here for weekend only__
g. Here for the day only__

18. On the average, including yourself, how many people typically go to the beach with you? _________

19. Is it usually <u>this</u> beach? Yes__ **[skip to # 21]** No__

20. **If "No," ask:** To which beach do you usually go? _______________

21. Do you usually have to buy a beach tag to use this beach? Y__ N__

22. **If yes:** Do you have a tag, and if so what kind is it:
1. Season 2. Week 3. Weekend 4. Day 5. No pay/no tag ____

23. **THERE ARE SEVERAL REASONS WHY YOU MIGHT CHOOSE TO VISIT NEW JERSEY'S BEACHES. PLEASE INDICATE HOW IMPORTANT EACH OF THE FOLLOWING REASONS IS TO YOU?** [**Codes:** 1-not at all important; 2-slightly important; 3-moderately important; 4-very important; 5-extremely important; 6- NA]

a. To be with a large number of people...................... 1 2 3 4 5 (6)
b. To experience the visual qualities of the beach scenery.. 1 2 3 4 5 (6)
c. To socialize with family, friends and others............. 1 2 3 4 5 (6)
d. To relax... 1 2 3 4 5 (6)
e. To participate in beach activities (swim, surf, etc)..... 1 2 3 4 5 (6)
f. To enjoy being alone..................................... 1 2 3 4 5 (6)
g. There is little or no cost to enjoy the beach............ 1 2 3 4 5 (6)
h. It is a wide enough beach to enjoy many activities....... 1 2 3 4 5 (6)
i. It is a nice family-oriented beach....................... 1 2 3 4 5 (6)
j. It is well protected by lifeguards....................... 1 2 3 4 5 (6)
k. It is well maintained.................................... 1 2 3 4 5 (6)
l. There is good fishing.................................... 1 2 3 4 5 (6)
m. It is close to where I am staying at the shore........... 1 2 3 4 5 (6)
n. It is close to my permanent residence.................... 1 2 3 4 5 (6)
o. There is enough parking.................................. 1 2 3 4 5 (6)
p. There are adequate snack bars and shops 1 2 3 4 5 (6)

THE NEXT QUESTIONS WILL HELP US MEASURE THE VALUE SOCIETY PLACES ON BEACHES. WE DO THIS BY ASKING ABOUT THE DOLLAR VALUE OF ENJOYMENT FOR A DAY ON THE BEACH. THESE ESTIMATES REFLECT ONLY PERSONAL VALUES AND WILL NOT INFLUENCE BEACH FEES. BEACH FEES ARE SET BY TOWNS; OUR RESEARCH IS FOR THE U.S. ARMY CORPS OF ENGINEERS.

24. Previous studies reveal that, on average, people would be willing to pay about $4.00 per day per person to use a beach in New Jersey. Do you feel that a day using a New Jersey beach would be worth $4.00 to each member of your household?

Yes__	OR	**No**__
If yes, do you feel that a beach day would be worth $5.00 to each member of your household?		**If no**, do you feel that a beach day would be worth $3.00 to each member of your household?
Yes__ **No**__		**Yes**__ **No**__
If yes, is it worth $6.00 per day?		**If no**, is it worth $2.00 per day?
Yes__ **No**__		**Yes**__ **No**__
If yes, how much would you be willing to pay per day to use beach in New Jersey?		**If no**, how much would you be willing to pay per day to use a beach in New a Jersey?
$____.____		$____.____

25. **[If respondent placed a monetary value in question 24, skip this question and go to question 26.. If respondent answered zero or did not state a monetary value to question 24, ask:]** Which of the following statements best describes the reasons for your response:
[Intvr: read choices]
Not enough information__
Did not want to place a dollar value__
Object to the way the question was presented__
That is what it is worth to me__
[don't read] Other (specify)______________ __

[Interviewer: Review for yourself final answer to question 24]

26. If an entry fee of____ **[the amount respondent indicated in question 24]** were charged, how would that affect the number of visits you would make to New Jersey's beaches?

More than now__ If more, how many more visits _____
Same as now __
Fewer than now. If fewer, how many fewer visits_____

27. **Interviewer: Show photographs of the two beaches -- "A" with sand replenishment; "B" without sand replenishment. Ask:]**
THIS SURVEY IS PART OF A STUDY TO ASSESS THE COSTS AND BENEFITS ASSOCIATED WITH BEACH SAND REPLENISHMENT.

Would you be willing to pay: More __ Less __ The Same __ than **[amount respondent stated in question 24]** if the NJ beach you usually visit were widened like the beach in Photo B [Bottom Photo]?

If more, how much more than__ **[amount stated in question 24]** $___.___
If less, how much less than__ **[amount stated in question 24]** $___.___

28. **[Interviewer: if answer to question 27 (directly above) was zero, skip to question 29; if answer to question 27 is greater than 0, ask:]**

If a beach fee of__ **[amount stated in question 27]** were charged, how would that affect the number of visits you would make to New Jersey's beaches?

More than now__ If more, how many more visits _____
Same as now __
Fewer than now. If fewer, how many fewer visits_____

29. This next question is not about widening beaches, but about maintaining beaches -- stopping them from eroding away. How important is it to you that there be a beach here at all?

1-not at all important; 2-slightly important; 3-moderately important; 4-very important; 5-extremely important; 6- NA]

30. Would you stop coming to this area if it did not have a beach?
Yes__ No__

31. Imagine there were a fund established for New Jersey beach protection against erosion. If you were to make a voluntary once-a-year contribution to this fund, even if you did not use the beach, what would be the maximum yearly amount that you would be willing to give?

Keep in mind that this contribution would be <u>in addition</u> to any daily fees that you might pay? $______.___

32. **[Intvr: If respondent's answer to question 31 is greater than zero, skip to question 33; if respondent's answer to question 31 equals zero, ask:]**

Which of the following statements best describes the reasons for your response: **[Intvr: read choices]**

Not enough information__
Did not want to place a dollar value__
Object to the way the question was presented__
That is what it is worth to me__
[don't read] Other (specify)________________________

33. **All in all, how expensive do you consider a trip to the beach**
[Intvr: read choices]

a. very expensive__
b. somewhat expensive__
c. somewhat inexpensive
d. very inexpensive

LAST SET OF QUESTIONS: WE NEED TO MAKE SURE WE'VE TALKED WITH THE FULL RANGE OF BEACH USERS:

34. Which best describes your present employment status?

Employed full-time__
Employed part-time__
Not employed__
Retired__
Full-time homemaker__
Student__
Other (specify)____________________

35. Are you married or single? M S

36. Which best describes your total household income, before taxes?
[Intvr: read list and/or show card; ask only for letter]

a. Under $10,000__
b. $10,000 - $19,999__
c. $20,000 - $29,999__
d. $30,000 - $39,999__
e. $40,000 - $49,999__
f. $50,000 - $74,999__
g. $75,000 - $99,999__
h. $100,000 and over__

37. How many people are in your household this year?____

38. How much education have you completed?
[Intvr: read list and/or show card, ask only for letter]

a. No school (0 yrs) __
b. Grade school (6 yrs) __
c. Some High School (7-11 yrs)__
d. High School Graduate (12 yrs)__
e. Some College (13-15 yrs) __
f. College Graduate (16 yrs) __
g. Post Graduate (over 16 yrs)__

39. How would you describe your racial or ethnic background?

White or Caucasian __
Black or African American__
Latino__
Asian__
Native American__
Other (specify)______________

40. Which best describes your age group?
[Intvr: read list and/or show card, ask only for letter]

a. 10 - 19__
b. 20 - 29__
c. 30 - 39__
d. 40 - 49__
e. 50 - 59__
f. 60 - 69__
g. 70+ __

41. To help the design of future questionnaires, overall how did you find the wording and reasonableness of the questions we have asked?

Very Clear__ Clear__ Moderate__ Unclear__ Very Unclear__

42. Do you have any other comments or suggestions you would like to make regarding New Jersey's ocean beaches?

____

6/9/94 **NEW JERSEY HOMEOWNERS BEACH SURVEY** -- ABSECON AND SEVEN MILE ISLANDS
For those 18 or older, preferably the homeowner.

1. M__ __ D__ __ Y__ __ 2. Day of Wk (1-7) ____ 3. Tm __ __:__ __
4. Intvr.# __ __ 5. Coder #___ 6. Location: 1-Stone Harbor 2-Avalon 3-Atlantic City 4-Longport 5-Margate 6-Ventnor
6a: Number of blocks to beach______

INTRODUCTION: GOOD MORNING/AFTERNOON, I'M ____ FROM RUTGERS UNIVERSITY. THIS IS AN ANONYMOUS **4 MINUTE** QUESTIONNAIRE ON BEACH EROSION AND THE IMPORTANCE OF BEACHES. THIS STUDY IS CONDUCTED BY RUTGERS UNIVERSITY FOR THE U.S. ARMY CORPS OF ENGINEERS AND THE NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION.

7. Do you or your family own a residence along the N.J. shore? Yes__ No__
[If YES, continue interview. If NO, end interview: "Thank you but this questionnaire is only for homeowners." NOTE: you might want to ask respondents if they know which nearby houses are owner-occupied.

8. Is it <u>this</u> house? Yes__ No__

9. IF NO, In what community is your house______________ **[INTV: If in our 6 areas, continue interview. If <u>not</u> in our 6 areas, end interview and thank respondent; explain that survey only for our 6 areas.]**

10. Do you come to New Jersey beaches: **[Intvr: read choices]** Every year__ Most years__ Some years__ Or, is this your first year here__

11. **For how long are you staying at the N.J. shore this summer:**
[Intvr: read choices]
a. **Permanent resident** (all year)__
b. **Here all summer, all week**__
c. **Here mostly on weekends, but all summer**__
d. **Here for two weeks**__
e. **Here for one week**__
f. **Here for weekend only**__
g. **Here for the day only**__

12. **How many days do you estimate that you <u>will</u> spend on New Jersey beaches <u>this</u> summer, in total? (Beach visits only, do not count trips to the boardwalks, etc)** ______

13. **When did you buy your house? yr:______ (Inherit/fam.___)**

14. **If the beach were to erode away completely, how would this affect the value of your property? [INTV: if no immediate quantifiable answer, ask:]**
Would it lose:
a quarter of its value__ a half of its value__
three-quarters of its value__ almost all of its value__
all of its value__ other______________________________

15. **Do you know if any of the local taxes go toward replacing the sand lost to storms or waves? Yes__ Think so__ No___**

16. **Interviewer: Show photographs of the two beaches -- "A" with sand replenishment; "B" without sand replenishment. Ask:]**
THIS SURVEY IS PART OF A STUDY TO ASSESS THE COSTS AND BENEFITS ASSOCIATED WITH BEACH SAND REPLENISHMENT.

Would you be willing to pay: More <u>taxes</u> if the NJ beach you usually visit were widened like the beach in Photo B [Bottom Photo]?

If MORE__, ask how much more than you currently pay _______%
IF NO__
If LESS__, how much less than you currently pay ________%
NA: The beach is already wide, as in photo "A"___

17. This next question is not about widening beaches, but about maintaining beaches -- stopping them from eroding away. How important is it to you that there be a beach here at all?

1-not at all important; 2-slightly important; 3-moderately important; 4-very important; 5-extremely important; 6- NA]

18. Imagine there were a fund established for New Jersey beach protection against erosion. If you were to make a voluntary once-a-year contribution to this fund, even if you did not use the beach, what would be the maximum yearly amount that you would be willing to give?

Keep in mind that this contribution would be <u>in addition</u> to any taxes and daily fees that you might pay? $______.___

19. **[Intvr: If respondent's answer to question 18 is greater than zero, skip to question 20; if respondent's answer to question 18 equals zero, ask:]** Which of the following statements best describes the reasons for your response: **[Intvr: read choices]**
Not enough information__
Did not want to place a dollar value__
Object to the way the question was presented__
That is what it is worth to me__
[don't read] Other (specify)______________________

LAST SET OF QUESTIONS: WE NEED TO MAKE SURE WE'VE TALKED WITH THE FULL RANGE OF BEACH USERS:

20. Which best describes your present employment status?
Employed full-time__
Employed part-time__
Not employed__
Retired__
Full-time homemaker__
Student__
Other (specify)____________________

21. Are you married or single? M S

22. Which best describes your total household income, before taxes?
Intvr: read list
a. Under $10,000__
b. $10,000 - $19,999__
c. $20,000 - $29,999__
d. $30,000 - $39,999__
e. $40,000 - $49,999__
f. $50,000 - $74,999__
g. $75,000 - $99,999__
h. $100,000 and over__

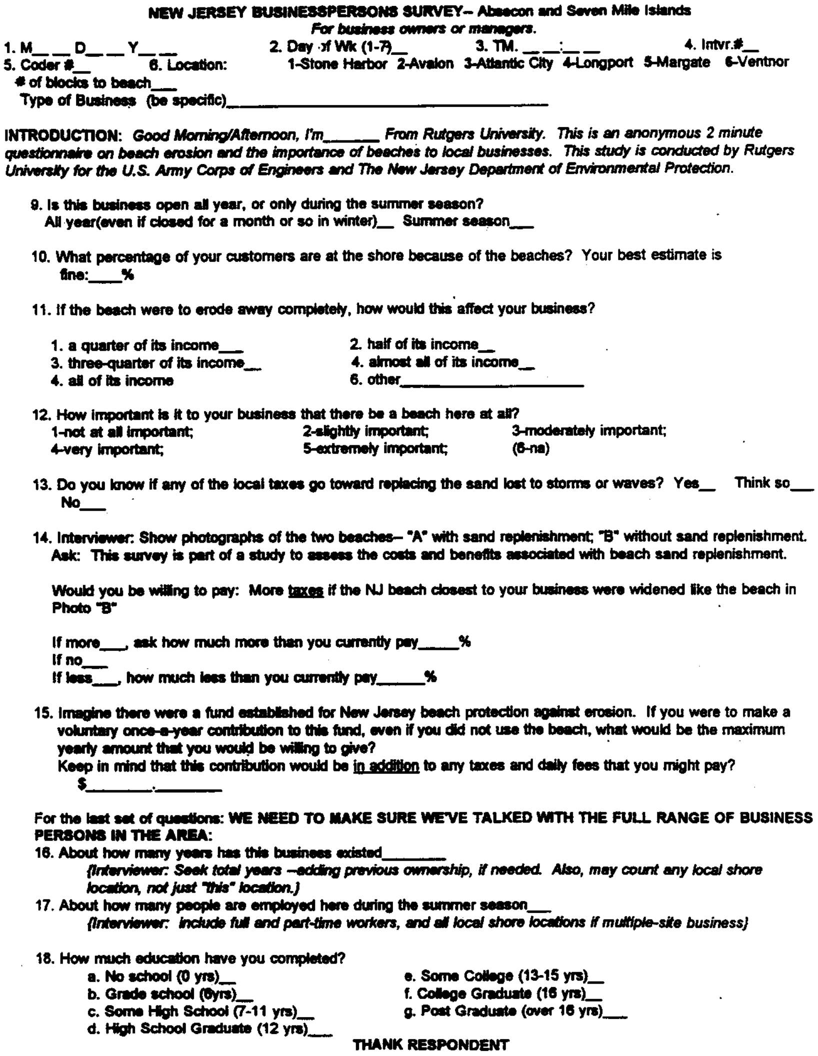
23. How many people are in your [regular] household this year?____

24. How much education have you completed?
[Intvr: read list
a. No school (0 yrs) __
b. Grade school (6 yrs) __
c. Some High School (7-11 yrs)__
d. High School Graduate (12 yrs)__
e. Some College (13-15 yrs) __
f. College Graduate (16 yrs) __
g. Post Graduate (over 16 yrs)__

25. How would you describe your racial or ethnic background?
White or Caucasian __ Black or African American__ Asian__
Latino__ Native American__ Other ______________

26. Which best describes your age group?
a. 10 - 19__ b. 20 - 29__ c. 30 - 39__ d. 40 - 49__
e. 50 - 59__ f. 60 - 69__ g. 70+ __

Thank Respondent



NEW JERSEY BUSINESSPERSONS SURVEY-- Absecon and Seven Mile Islands

For business owners or managers.

1. M___ D___ Y___ 2. Day of Wk (1-7)__ 3. TM. __ __:__ __ 4. Intvr.#__
5. Coder #__ 6. Location: 1-Stone Harbor 2-Avalon 3-Atlantic City 4-Longport 5-Margate 6-Ventnor
# of blocks to beach___
Type of Business (be specific)________________________________

INTRODUCTION: ***Good Morning/Afternoon, I'm______ From Rutgers University. This is an anonymous 2 minute questionnaire on beach erosion and the importance of beaches to local businesses. This study is conducted by Rutgers University for the U.S. Army Corps of Engineers and The New Jersey Department of Environmental Protection.***

9. Is this business open all year, or only during the summer season?
All year(even if closed for a month or so in winter)__ Summer season___

10. What percentage of your customers are at the shore because of the beaches? Your best estimate is fine:____%

11. If the beach were to erode away completely, how would this affect your business?

1. a quarter of its income___ 2. half of its income__
3. three-quarter of its income__ 4. almost all of its income__
4. all of its income 6. other______________________

12. How important is it to your business that there be a beach here at all?
1-not at all important; 2-slightly important; 3-moderately important;
4-very important; 5-extremely important; (6-na)

13. Do you know if any of the local taxes go toward replacing the sand lost to storms or waves? Yes__ Think so___ No___

14. Interviewer: Show photographs of the two beaches-- "A" with sand replenishment; "B" without sand replenishment.
Ask: This survey is part of a study to assess the costs and benefits associated with beach sand replenishment.

Would you be willing to pay: More taxes if the NJ beach closest to your business were widened like the beach in Photo "B"

If more___, ask how much more than you currently pay_____%
If no___
If less___, how much less than you currently pay______%

15. Imagine there were a fund established for New Jersey beach protection against erosion. If you were to make a voluntary once-a-year contribution to this fund, even if you did not use the beach, what would be the maximum yearly amount that you would be willing to give?
Keep in mind that this contribution would be in addition to any taxes and daily fees that you might pay?
$________.________

For the last set of questions: WE NEED TO MAKE SURE WE'VE TALKED WITH THE FULL RANGE OF BUSINESS PERSONS IN THE AREA:

16. About how many years has this business existed________
{Interviewer: Seek total years --adding previous ownership, if needed. Also, may count any local shore location, not just "this" location.}
17. About how many people are employed here during the summer season___
{Interviewer: include full and part-time workers, and all local shore locations if multiple-site business}

18. How much education have you completed?
a. No school (0 yrs)__
b. Grade school (8yrs)__
c. Some High School (7-11 yrs)__
d. High School Graduate (12 yrs)___
e. Some College (13-15 yrs)__
f. College Graduate (16 yrs)__
g. Post Graduate (over 16 yrs)___

THANK RESPONDENT

APPENDIX D

PERTINENT CORRESPONDENCE

Post-it® Fax Note 7671	Date 8/26/96 # of pages ▸ 3
To John Burnes	From Richard Kropp
Co./Dept. COE	Co. NJDEP
Phone # 215-656-6540	Phone # 609-984-3444
Fax # 215-656-6545	Fax # 609-292-8115

State of
Department of En

Christine Todd Whitman
Governor

Commissioner

August 26, 1996

Robert L. Callegari
Planning Division
Department of the Army
Philadelphia District
Philadelphia, Pennsylvania 19107

RE: Water Quality Certification and Federal
Consistency Statement Request.
Absecon Island Dredging/Beach Fill Study
LURP File No. 0000-96-0002.2
Atlantic City, Ventnor, Margate and Longport
Atlantic County

Dear Mr. Callegari:

The New Jersey Department of Environmental Protection, Land Use Regulation Program, acting under Section 307 of the Federal Coastal Zone Management Act (P.L. 92-583) as amended, has reviewed the "Absecon Island Interim Feasibility Study, Volume 1," dated April 1996. Based on the information submitted the Program has determined that the project as discussed in the submitted feasibility study, is consistent with New Jersey's Rules on Coastal Zone Management, N.J.A.C. 7:7E, as amended to August 19, 1996 and the applicable Rules guiding issuance of a Section 401 Water Quality Certificate, provided the conditions discussed below are met to the satisfaction of the Department.

Project Description

The project is intended to provide storm and erosion protection for the coastal communities of Atlantic City, Ventnor, Margate and Longport. The project includes the dredging and placement of sand on the beach with a periodic replenishment of dredged sand every 3 years over a 50 year project life. In addition, the plan provides for bulkheads at unprotected areas of the Absecon Inlet frontage.

This consistency determination is based on the following conditions being met:

1. In Atlantic City, the selected plan berm width of 200 feet which maximizes net benefits from a federal standpoint may be less desirable than a lesser scale plan with potentially less environmental impact but approaching the selected alternative in storm damage protection. Since the destruction of surf clam areas is prohibited (7:7E-3.3), in order to reduce impacts to surf clam areas, an alternative with a lesser berm width (150', Alternatives CX or CY) must be implemented unless sufficient information is provided to demonstrate that these alternatives do not fulfill the project purpose or do not reduce impact to surf clam areas.

2. The proposed bulkhead sections should be located behind the beach and above the spring high water line in order to met the Rules concerning Beaches (7:7E-3.22), Intertidal and Subtidal Shallows (7:7E-3.15), Filling (7:7E-4.2(j)) and Coastal Engineering (Structural Shore Protection Structures) (7:7E-7.11(e)). Coordination with the Land Use Regulation Program during design studies must be accomplished to determine an alignment which meets these rules.

3. In order to meet the Surf Clam Areas Rule (7:7E-3.3), either utilize, or provide specifics which justify, to the Program's satisfaction, dismissing the use of, the interior of the Absecon Inlet site along Brigantine to reduce the destruction of surf clam areas. The information provided should evaluate areas outshore of the beaches and dunes. The information should also include a characterization of the substrate materials.

4. Locations and plans for access through the dunes must be provided in accordance with the requirements set forth in the Dune rule (7:7E-3.16) and the standards set forth at Subchapter 3A that are applicable.

5. The Army Corps of Engineers is required to provide the monitoring plan as described in the submitted feasibility study (page 202, paragraph 492) within 30 days of the date when the first funds for preconstruction engineering and design are received in the district. This monitoring plan was not included in the feasibility study. The monitoring plan must provide for the assessment of recolonization of the borrow area by surf clams.

6. In order to reduce the loss of surf clam areas, prior to deciding where to obtain borrow material for future beach replenishment, the previously used portions of the borrow area shall be evaluated and the expansion into unused portions of the borrow area restricted.

Revised plans and supporting information for each of the above conditions must be submitted to the Land Use

Regulation Program for review and approval at least 90 days prior to soliciting bids on the project.

Pursuant to 15 CFR 930.44, the Program reserves the right to object and request remedial action if this project is conducted in a manner, or is having an effect on, the coastal zone which is substantially different than originally proposed.

If you have any questions concerning this determination please contact Catherine Krause, of my staff, at the above address or at (609) 984-0288.

Sincerely,

Richard Kropp, Director
Land Use Regulation Program

cc: Lawrence Schmidt
James Hall, Assistant Commissioner

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A PROFESSIONAL CORPORATION
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DAVID S. LIEBERMAN*
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WAYNE R. ROSENLICHT (1954-1990)

COUNSEL TO THE FIRM
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STEPHANIE ONORATO

*CERTIFIED CIVIL TRIAL ATTORNEY
**RESIDENT ATTORNEYS VOORHEES OFFICE
***RESIDENT ATTORNEYS EAST BRUNSWICK OFFICE

DIRECT DIAL: 343-7804

REPLY TO: Atlantic City

November 1, 1991

NOV 05 1991

Congressman William Hughes
Central Park East
Building 4, Suite 5
222 New Road
Linwood, New Jersey 08221

Dear Congressman Hughes:

I've been following with great interest your success with the Cape May City Beach Replenishment Project and the soon to occur Great Egg Harbor Inlet dredging and replenishment of Ocean City beaches.

We who live on the Point in Longport, New Jersey across Great Egg Harbor from Ocean City have faced a rapidly deteriorating problem with the beaches on the bay side of the Point where the sand has been completely stripped away and we are rapidly approaching the bottom limit of our bulkheads. If there were any potential to pump sand from the dredging of Great Egg Harbor Inlet to that side of Longport as well as the beaches in Ocean City we would be eternally grateful.

I also would like to voice my opinion that the only thing that's going to stabilize Ocean City's beaches as well as Longport beaches is to create a real inlet such as the Atlantic City Inlet which in the short term is expensive, but would save

money over the future, since you would not have to constantly redredge Great Egg Harbor Inlet, or protect the beaches or both sides of the inlet.

I would appreciate a response and I'd also like to know when the public hearings are proposed for the dredging of Great Egg Harbor Inlet and the Ocean City Beach Replenishment Project.

Thank you.

Very truly yours,

John Walker Daniels

1101 Atlantic Avenue
Longport, New Jersey 08403

News Clips

US Army Corps
of Engineers
Philadelphia District

Atlantic City N.J. Press Dec. 4, 1994

Public Affairs Office

Battle for beaches goes on in A.C.

■ The city has been building up dunes and planting dune grasses. The work seems to slow the losses, but the beaches are still getting thinner. New weapons are being sought, such as pumps that will move sand from under the Boardwalk into bags that would anchor dunes. 200 AH

By MICHAEL PRITCHARD
Staff Writer

ATLANTIC CITY — City workers have been bracing for another winter of northeasters to prevent more of the city's most valuable resource — the beaches — from slipping away with the tide.

But while the city has once again lined its beaches with dunes and dune grass, officials say it's only a matter of time before man will have to replace what nature took away.

"We are definitely going to need a major beach replenishment project eventually," said Robert Levy, city Beach Patrol chief. "We are in the Army Corps of Engineers replenishment program, but unfortunately it could be up to four years before they can get to us.

"In the meantime all we can do is try and fight the erosion with the dunes and the dune grass," Levy said.

The first test came last weekend as Hurricane Gordan churned up strong surf along the eastern seaboard.

The city's network of dunes held up well.

"We didn't make out too badly at all," Levy said. "In some areas we lost the fronts of the dunes. But they've been built back up. Now we just have to see how they hold up in the next storm."

The city creates the dunes from sand that washes under the Boardwalk, to form a barrier to keep waves from damaging the wooden way. To bolster the dunes, dune grass is planted. The grass, however, needs time to take hold and

See Sand, Page C4

> 'We are definitely going to need a major beach replenishment project eventually. ... In the meantime all we can do is try and fight the erosion with the dunes and the dune grass.'
>
> Robert Levy,
> Beach Patrol chief

COMMITTEE ON THE JUDICIARY
SUBCOMMITTEE ON INTELLECTUAL PROPERTY AND JUDICIAL ADMINISTRATION (CHAIRMAN)
COMMITTEE ON MERCHANT MARINE AND FISHERIES
SELECT COMMITTEE ON AGING
SUBCOMMITTEE ON RETIREMENT INCOME AND EMPLOYMENT (CHAIRMAN)
SELECT COMMITTEE ON NARCOTICS ABUSE AND CONTROL

Congress of the United States
House of Representatives
Washington, DC 20515

DISTRICT OFFICES
CENTRAL PARK EAST
BUILDING 4, SUITE 3
222 NEW ROAD
LINWOOD, NJ 08221
(609) 927-9063

151 NORTH BROADWAY
P.O. BOX 248
PENNSVILLE, NJ 08070
(609) 678-3333

November 8, 1991

Mr. John Walker Daniels, Esq.
1101 Atlantic Avenue
Longport, NJ 08403

Dear Mr. Daniels:

Thank you for your letter regarding the need for inlet and beach stabilization in Longport and Ocean City along the Great Egg Harbor Inlet.

As you noted, I have been actively involved with both the Army Corps of Engineers and the New Jersey Department of Environmental Protection and Energy to secure funds for dredging and beach nourishment projects. These agencies understand our problems and, within the constraints of their limited resources, they have been very responsive to our needs.

I appreciate your comments regarding methods to improve conditions in the vicinity of the Great Egg Harbor Inlet. The Corps of Engineers is conducting a New Jersey Shoreline Study to consider such issues and I have asked them to review your suggestions.

With kindest regards,

Sincerely,

Bill Hughes

William J. Hughes
Member of Congress

WJH:jhm
cc: Lieutenant Colonel Kenneth Clow

Civil Project Management Branch

Honorable William J. Hughes
Representative in Congress
Central Park East
Building 4, Suite [illegible]
222 New Road
Linwood, New Jersey [illegible]

Dear Mr. Hughes:

This is in reference to your [illegible] [illegible] [illegible], [illegible] Mr. John Walker Daniels, Esq. regarding the need for [illegible] [illegible] stabilization in Longport and Ocean City along Great Egg Harbor Inlet.

As you are aware, the Great Egg Harbor Inlet and Peck Beach Project was reauthorized by Section 501(a) of the Water Resources Development Act of 1986. The ongoing project is to provide for beachfill and periodic nourishment for shore protection in Ocean City using material dredged from the Great Egg Harbor Inlet ebb shoal approximately 3,000 feet offshore. The current project will not include dredging of the inlet for navigation purposes, and thus there is no sand available from inlet dredging to be dumped on the beaches at Longport, as Mr. Walker suggests. Public workshops, meetings and agency coordination were conducted for the project, culminating in the completion of the General Design Memorandum and Final Supplemental Environmental Impact Statement for the project in April 1989. As part of the planning process in that report, jetties for Great Egg Harbor Inlet were considered. It was determined that such structures would incur a prohibitively high cost due to the length of structures required in comparison to other beachfill features.

The Corps of Engineers is currently conducting the New Jersey Shore Protection Study. The purpose of this study is to investigate shore-protection and water quality problems along the New Jersey coast extending from Sandy Hook to Cape May Point. We completed the limited reconnaissance phase of the New Jersey Shore Protection Study in September, 1990. As a result of this phase, we recommended six full reconnaissance studies. Longport is included in the study area from Brigantine Inlet to Great Egg Harbor Inlet. That reconnaissance was initiated in February 1991. The lack of protected beach berm and dunes in Longport was noted in the limited Reconnaissance Report and was again inspected during the present study and after the October 31, 1991 and January 4, 1992 coastal storms.

If we may be of any further assistance, please do not hesitate to contact us.

Sincerely,

Kenneth H. Clow
Lieutenant Colonel, Corps of Engineers
District Engineer

Copy Furnished:

Honorable William J. Hughes
House of Representatives
Washington, DC 20515

DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
WANAMAKER BUILDING, 100 PENN SQUARE EAST
PHILADELPHIA, PENNSYLVANIA [illegible]

REPLY TO
ATTENTION OF
Planning Division

JUN [illegible] 1993

NOTICE OF STUDY INITIATION

This notice is to announce the feasibility phase initiation of the Brigantine Inlet to Great Egg Harbor Inlet reach of the New Jersey Shore Protection Study. The Corps of Engineers is conducting this study in response to resolutions adopted by the Committee on Public Works and Transportation of the U.S. House of Representatives and the Committee on Environment and Public Works of the U.S. Senate in December, 1987. This study is being sponsored by the New Jersey Department of Environmental Protection and Energy (NJDEPE).

The purpose of the study is to investigate shoreline erosion and storm damage problems along the Atlantic coast of New Jersey with a view to providing shore protection, beach erosion control, hurricane protection, and environmental analysis of ecologically important areas. The study will collect a physical and environmental database of coastal area changes and processes, including appropriate monitoring during development of the database, as the basis for actions to prevent the harmful effects of further shoreline erosion and storm damage.

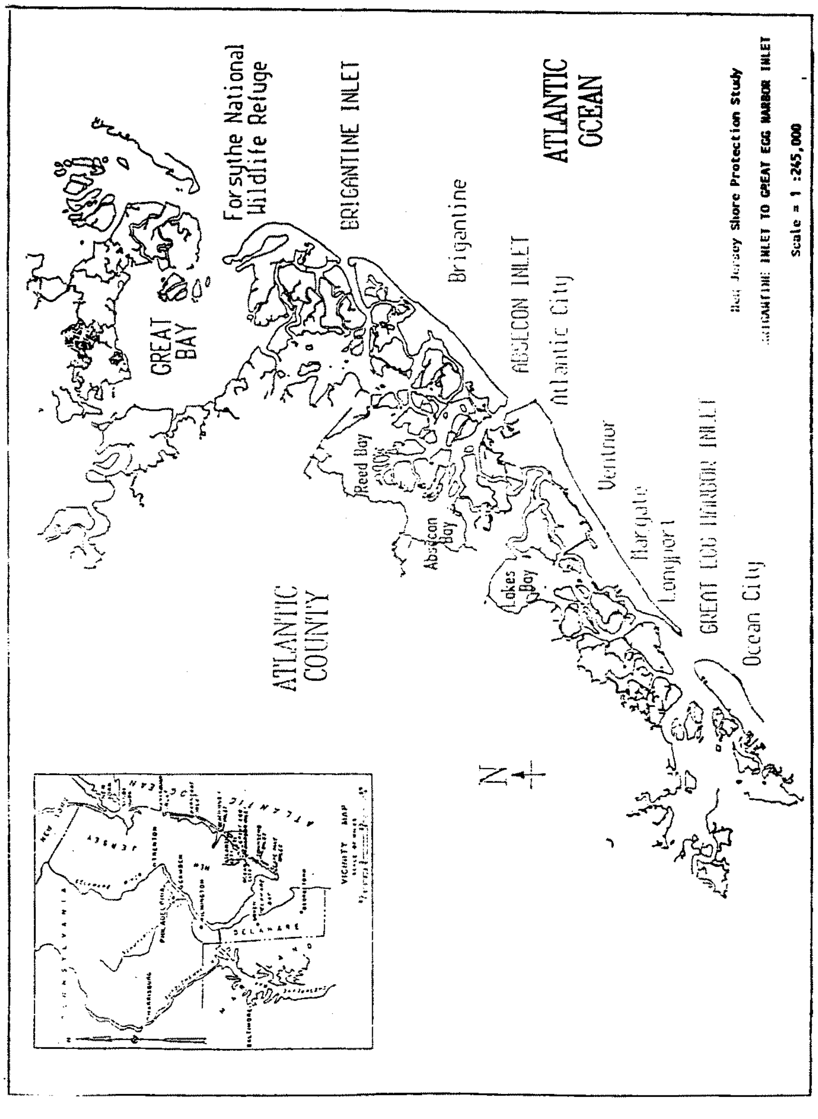
The first phase of the study, the reconnaissance phase, was completed in [illegible] at 100% Federal cost. The reconnaissance phase established that there is Federal interest in establishing shoreline protection measures along the Atlantic coast of New Jersey for both Brigantine and Absecon Islands. The feasibility phase began on 1 March 1993 and is being cost shared 50%-50% between the State of New Jersey (NJDEPE) and the Federal government. The feasibility study will investigate shore protection problems, develop detailed solutions and an economic assessment of the viability of each chosen solution. Additionally, the feasibility study will include an assessment on the level of interest and support of non-Federal parties in the identified potential solutions, and establish the scope and schedule for the construction of future shore protection measures.

Any pertinent information that Federal, State or local agencies and the private sector can provide will be used to the greatest extent possible. We welcome any assistance and suggestions pertaining to the conduct of this study. All comments should be directed to the above address, ATTN: CENAP-PL-PC.

James F. Hall
Assistant Commissioner
New Jersey Department of
Environmental Protection and Energy

R.F. Sliwoski

R.F. Sliwoski, P.E.
Lieutenant Colonel,
Corps of Engineers
District Engineer



New Jersey Shore Protection Study

BRIGANTINE INLET TO GREAT EGG HARBOR INLET

Scale = 1 :245,000

HORN, GOLDBERG, GORNY, DANIELS,
PAARZ, PLACKTER & WEISS

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* CERTIFIED CIVIL TRIAL ATTORNEY
** RESIDENT ATTORNEYS VOORHEES OFFICE

July 14, 1993

REPLY TO: ATLANTIC CITY

Department of the Army
Philadelphia District Corps of Engineers
Wanamaker Building
100 Penn Square, East
Philadelphia, PA 19107-3391
Attn: CENAP-PL-PC

Dear Sir:

Please note that I live on Great Egg Harbor Inlet in Longport, New Jersey. My house is the last house on Atlantic Avenue on the bayside of Longport. Due to its location, I have had a wonderful opportunity to observe shoreline erosion and storm damage.

At the present time, we are experiencing a period of beach build-up and for the first summer in the last several years, we have a definite beach and protection behind our house. I attribute this to whatever changes have been made in the inlet by the dredging maintenance program, and I would invite you at any time to use our property as a monitoring point or whatever else you would like to experiment with in an attempt to identify potential solutions for shore protection measures.

I can be reached at anytime at the above address and telephone number.

Very truly yours,

John W. Daniels

HANKIN, SANDSON & SANDMAN
COUNSELLORS AT LAW
A PROFESSIONAL CORPORATION
30 SOUTH NEW YORK AVENUE
ATLANTIC CITY, NJ 08401

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Member of New Jersey
and District of Columbia Bars

MARK H. SANDSON
Member of New Jersey
and Georgia Bars

ROBERT S. SANDMAN
Certified Civil Trial Attorney
Member of the New Jersey
and Pennsylvania Bars

THOMAS F. BRADLEY
Member of the New Jersey
and Pennsylvania Bars

JOHN F. PALLADINO
Member of the New Jersey Bar

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(609) 344-7913

Our File Number

September 29, 1993

Lt. Colonel Kenneth H. Clow
Department of the Army
Philadelphia District
Corps of Engineers
Custom House 2nd and Chestnut Streets
Philadelphia, PA 19106-2991

Dear Lieutenant Colonel Clow:

I have read with interest the New Jersey Shore Protection Study "Brigantine Inlet to Great Egg Harbor Inlet" which was the subject of a reconnaissance study report by the U.S. Army Corps of Engineers, Philadelphia District, in February of 1992.

Given the substantial changed circumstances which exist along the Longport shoreline which abuts the Great Egg Harbor Inlet, I suggest that the reconnaissance study report be revised accordingly.

Since the completion of the reconnaissance study report, the dredging project in Great Egg Harbor has been completed, following which and within a four (4) week period, the tip of Longport has lost approximately 800 linear feet of beach and a height of some 13 to 14 feet. All of this has been without the aid of any unusual tides or storms. The "mysterious" disappearance of the beach is nothing less than bizarre. Without attributing what I conceive to be the reason for this substantial loss of beach, it is important for your report to reflect what has occurred here. Enclosed you will find photocopies of pages 54 and 55 of the report. Please note the substantial amount of beach between the 11th Avenue and Point Drive terminal groins.

Without the benefit of a revised study, it seems to me that the reconnaissance study report will serve no useful purpose.

Kindly let me hear from you at your very earliest convenience.

Thank you very much.

Very truly yours,

STEPHEN HANKIN
SH/js
Enclosure
cc: U.S. Congressman William J. Hughes
Central Park East
Building 4, Suite 5
222 New Road
Linwood, NJ 08221

Robert L. Callegari, Chief, Planning Division
U.S. Army Corps of Engineers
Philadelphia District
Custom House 2nd and Chestnut Streets
Philadelphia, PA 19106-2991

Lynn Bocamazo, Engineer
U.S. Army Corps of Engineers
New York District
CENAN-PL-CE
26 Federal Plaza, Room 2155
New York, NY 10278-0090

Bruce Ebersole, Chief, Coastal Processes Branch
Coastal Engineering Research
Waterways Experiment Station
U.S. Army Corps of Engineers
CEWES-CR-P
3909 Halls Ferry Road
Vicksburg, MS 39180-6199

Bernard J. Moore, Administrator
Engineering and Coastal Element
Environmental Regulation Wing
New Jersey Department of
Environmental Protection and Energy
1510 Hooper Avenue
Toms River, NJ 08753

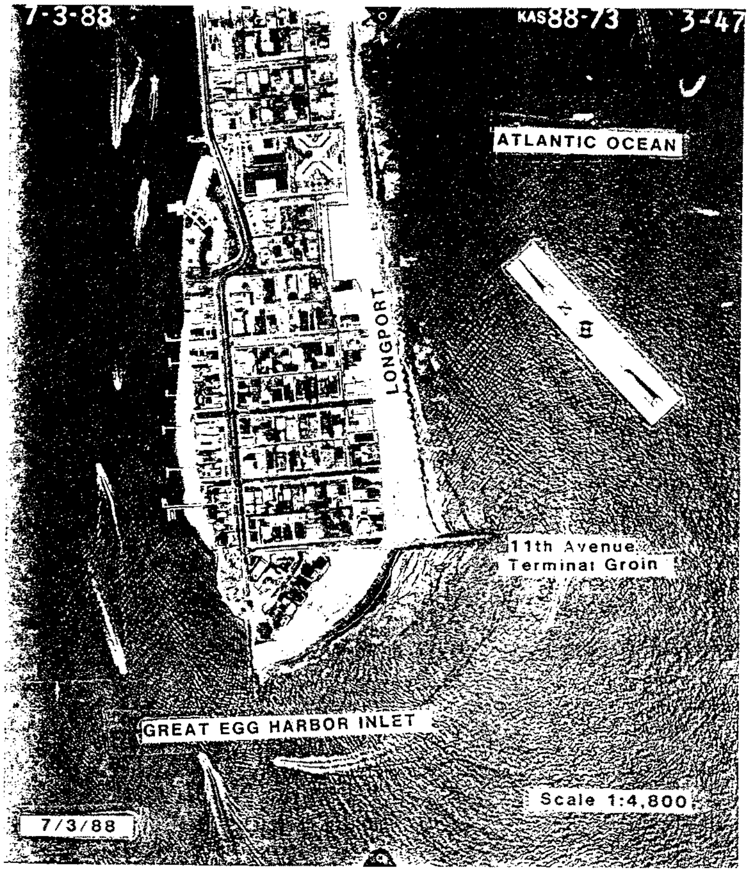


FIGURE 11. Southern end of Longport, NJ - July 1988. Note the shoreline configuration on the ocean and bay sides for comparison to Figure 12. This photograph was taken during high tide.

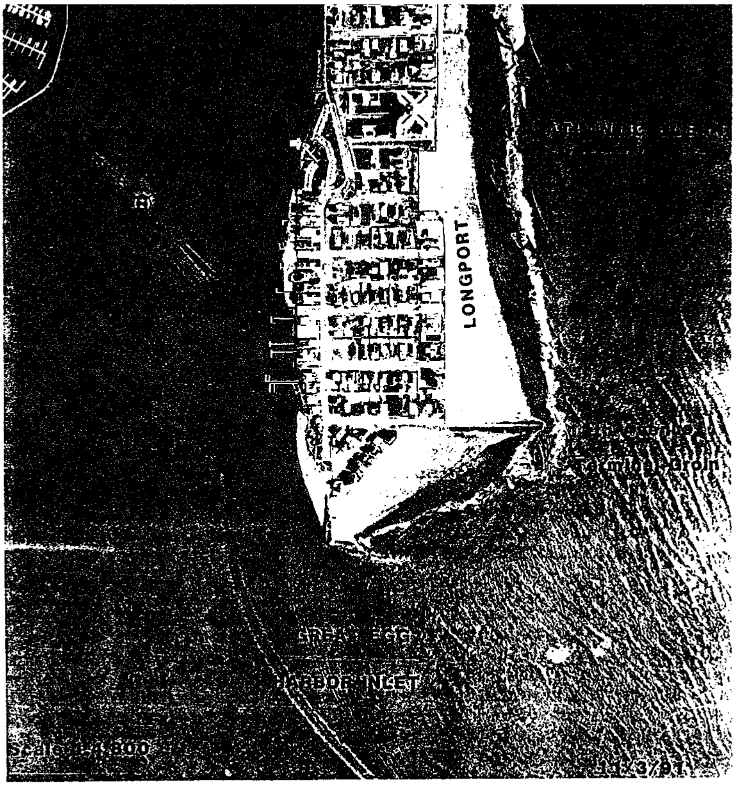


FIGURE 12. Southern end of Longport, NJ - November 1991, Low Tide. Note the bulkheads and lack of sand under the piers on the bay side. In comparison to Figure 11, the apparent increase in fillet width at the 11th Avenue groin may be due to 1) the 1990 beachfill, 2) ephemeral effects of the 1991 Halloween Storm or 3) low tide.

The Inquirer
Monday, September 6, 1993

They used to live on the beach. But since July, Stephen Hankin and his daughter, Ashley, have [illegible] the base of their home in Longport. Hankin blames Ocean City's beach-replenishment project across Great Egg Harbor [illegible]

Rapid erosion leaves Longport beached

In just weeks, the community's shore vanished. Even seasoned residents are baffled. And newly vulnerable.

By William H. Sokolic
INQUIRER CORRESPONDENT

LONGPORT — Before July, Shirley Gindhart used to be able to step off the deck behind her beige two-story oceanfront home on Point Drive and onto a beach wide enough for sunbathing.

But no more.

Now if she were to step off that wooden deck, Gindhart would take a [illegible]-foot plunge into the surf.

Gindhart and her neighbors have watched the sand in their back yards disappear into the ocean, leaving only a bulkhead as protection.

"[The disappearance] started July 4 and most of the sand was gone in four weeks," she said.

Her neighbor, Stephen Hankin, a [illegible]-year resident of Point Drive, described the rapid loss as bizarre.

Said Longport Mayor William Fiore: "I've lived here since 1949, and the sand has come and gone in that area. But I've never seen it go like that. On July 4th we were worrying about how to keep the beach clean. We're talking a substantial amount of sand lost."

Fiore and others worry that the vanishing sand leaves the palatial homes along a stretch from Point Drive to 11th Avenue vulnerable to stormy seas, especially with the storm season kicking into gear.

In last December's storm, [illegible] here were doused and flooded [illegible] with the beach, Gindhart said. During a typical high tide these days, sprays of water shoot up from the base of the exposed bulkhead and onto the houses. Continued pounding by the waves could undermine the bulkhead, a wooden barrier between the homes and ocean, [illegible] engineers say.

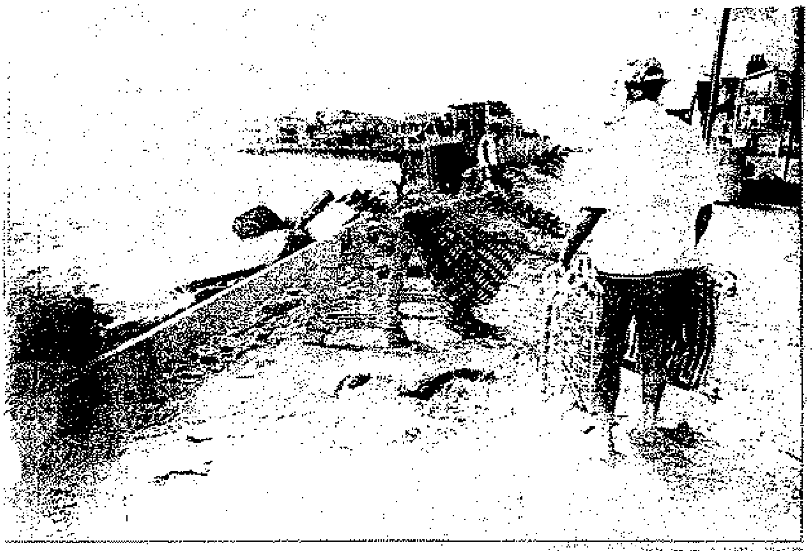
To stay those worries, the state Department of Environmental Protection and Energy has ordered emergency work to build a barrier between the bulkhead and the water to break the force of the waves. The emergency plan calls for the addition of a [illegible] revetment, essentially a rock barrier, between the 11th Avenue and Atlantic Avenue [illegible] that [illegible] the [illegible] beach.

The [illegible] of the [illegible] remains [illegible] [illegible] Ocean City for the disappearance. Ocean City lies across the Great Egg Harbor Inlet from Longport, and Ocean City [illegible] a [illegible] of sand [illegible] than $25 million beach replenishment project.

"There's no question the dredge project is responsible," Hankin said. "It's one [illegible] ground with Mother Nature. We have to go after those responsible."

The sand for the replenishment didn't come from Longport — the borough has [illegible]. Instead, it came from the mouth of the inlet. Hankin [illegible] among the Longport [illegible] that the [illegible]

See LONGPORT on [illegible]



Near 11th Street, the [illegible] Longport Mayor William [illegible]

Rapid erosion leaves Longport beached

LONGPORT [illegible] in the inlet were somehow altered by dredging up the sand in a location different from the [illegible] mapped out, and in the process, washed out Longport's tip.

But it's not an easy point to prove, said Kenneth Smith, a coastal consultant for Longport.

Indeed, engineers with the [illegible] have all but dismissed the dredge theory. "There's no evidence to the [illegible] that the dredging went outside the [prescribed] area," said Bernard Moore, chief of the state Bureau of Coastal Engineering.

Moore says a northern migration of the channel, the deepest point in the inlet, may well be the culprit behind the sand loss.

"The fast current in the new channel allowed waves to come closer to shore before breaking, and it [illegible] of the theory. But Moore has no ready explanation for the channel's movement to the north.

The former beach did have a tendency to come and go in width over the years. "For quite a few years the beach would leave in the fall and come back in the spring," [illegible] said.

But it has been around for about a decade, and [illegible] Longport's history [illegible] it's no wonder they [illegible] alarm.

Early in the century, the sea gobbled up the first 10 blocks of the borough, which explains why the [illegible] street is called [illegible] Avenue.

And since the beach disappeared, the only thing separating 11th Avenue from the ocean is a fence, a loose collection of rocks — and the former beach.

[illegible]

The DEPE wants to [illegible] emergency work.

[illegible] a handful of [illegible]

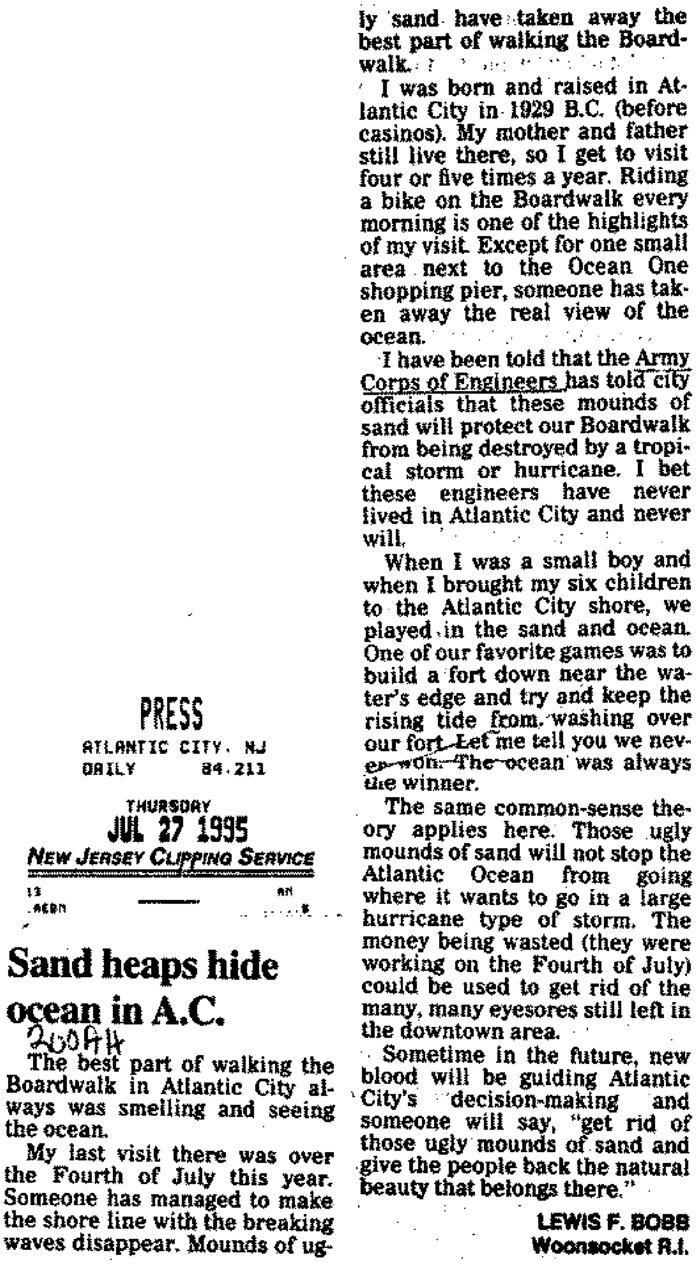
[illegible]

[illegible] special assessment against property owners along the affected area to pay the [illegible]

[illegible]

[illegible] In the meantime, [illegible]

[illegible]



PRESS
ATLANTIC CITY, NJ
DAILY 84,211

THURSDAY
JUL 27 1995
NEW JERSEY CLIPPING SERVICE

13 AM

Sand heaps hide ocean in A.C.

200ftk

The best part of walking the Boardwalk in Atlantic City always was smelling and seeing the ocean.

My last visit there was over the Fourth of July this year. Someone has managed to make the shore line with the breaking waves disappear. Mounds of ugly sand have taken away the best part of walking the Boardwalk.

I was born and raised in Atlantic City in 1929 B.C. (before casinos). My mother and father still live there, so I get to visit four or five times a year. Riding a bike on the Boardwalk every morning is one of the highlights of my visit. Except for one small area next to the Ocean One shopping pier, someone has taken away the real view of the ocean.

I have been told that the Army Corps of Engineers has told city officials that these mounds of sand will protect our Boardwalk from being destroyed by a tropical storm or hurricane. I bet these engineers have never lived in Atlantic City and never will.

When I was a small boy and when I brought my six children to the Atlantic City shore, we played in the sand and ocean. One of our favorite games was to build a fort down near the water's edge and try and keep the rising tide from washing over our fort. Let me tell you we never won. The ocean was always the winner.

The same common-sense theory applies here. Those ugly mounds of sand will not stop the Atlantic Ocean from going where it wants to go in a large hurricane type of storm. The money being wasted (they were working on the Fourth of July) could be used to get rid of the many, many eyesores still left in the downtown area.

Sometime in the future, new blood will be guiding Atlantic City's decision-making and someone will say, "get rid of those ugly mounds of sand and give the people back the natural beauty that belongs there."

LEWIS F. BOBB
Woonsocket R.I.

CENAP-PL-PC
[illegible] OCTOBER 1993
sm/6574
GAFFNEY

TUNNELL

BURNES

CALLEGARI

HISSMAN

[illegible]

Planning Division

Stephen Hankin
Hankin, Sandson & Sandman
30 South New York Avenue
Atlantic City, New Jersey 08401

Dear Mr. Hankin:

This is in response to your letter dated September [illegible] regarding the loss of beach at the southern end of Longport.

As you accurately point out, the Brigantine Inlet to Great Egg Harbor Inlet Reconnaissance was completed in February [illegible]. The Reconnaissance Report represents findings of the Corps of Engineers as of that date, for the purposes of determining whether Federal interest in shore protection exists for the study area. The results were positive and therefore the study has progressed into the feasibility phase.

The Borough of Longport is included in the Feasibility Study which began in March 1993. This study is cost shared with the New Jersey Department of Environmental Protection and Energy. Appropriate data are being collected during this phase of study in an effort to better understand the natural forces which are responsible for sand transport along Absecon Island.

As part of the normal conduct of this study, my staff routinely contacts municipal officials and makes site visits to ascertain the problems as they exist in any study area. We are fully aware of the recent loss of sand at the southern end of Longport, the State's ongoing remedial measures, as well as the dynamic historical nature of the barrier islands along the coast of New Jersey. During the course of the study, all relevant information will be assessed to develop an effective shore protection project for Longport and Absecon Island.

I hope this information is satisfactory for your needs. Should you have additional questions, please do not hesitate to contact me.

Sincerely,

R. F. Sliwoski, P.E.
Lieutenant Colonel, Corps of Engineers
District Engineer

WILLIAM J. HUGHES
2D DISTRICT, NEW JERSEY

COMMITTEE ON THE JUDICIARY
SUBCOMMITTEE ON INTELLECTUAL
PROPERTY AND JUDICIAL
ADMINISTRATION (CHAIRMAN)
COMMITTEE ON MERCHANT
MARINE AND FISHERIES

Congress of the United States
House of Representatives
Washington, DC 20515-3002

WASHINGTON OFFICE
241 CANNON HOUSE OFFICE BUILDING
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PENNSVILLE, NJ 08070
(609) 578-3333

October 1, 1993

Mr. Stephen Hankin, Esq.
Hankin, Sandson & Sandman
30 South New York Avenue
Atlantic City, NJ 08401

Dear Mr. Hankin:

Thank you for sending me a copy of your letter to the Army Corps of Engineers regarding the New Jersey Shore Protection Study.

In an effort to be of some assistance, I have again contacted the Corps of Engineers in your behalf. I have asked them to carefully consider your comments and suggestions and to make every reasonable effort to address your concerns.

With kindest regards,

Sincerely,

/s/
William J. Hughes
Member of Congress

WJH:jhm
cc: Lieutenant Colonel Richard Sliwoski

State of New Jersey
Department of Environmental Protection and Energy
Division of Science and Research
CN 409
Trenton, NJ 08625-0409
Tel. # 609-984-6070
Fax. # 609-292-7340

Jeanne M. Fox
Acting Commissioner

Robert K. Tucker, Ph.D.
Director

January 19, 1994

Mr. Robert L. Callegari
Department of the Army
Philadelphia District, Corps of Engineers
Wanamaker Building, 100 Penn Square East
Philadelphia, PA 19107-3391

Dear Mr. Callegari,

Based on the digital Data Distribution Agreement of [illegible] the Office of Information Resources Management, NJDEPE, is pleased to assist the Corps of Engineers with the Brigantine Inlet to Great Egg Harbor Inlet feasibility study. Enclosed you will find a QIC150 tape with ARC/INFO EXPORT files that you have requested written using the UNIX TAR command. Data documentation in hard copy and/or digital form is also enclosed.

Not all the coverages requested are available for the study area in Atlantic County. On your list, numbers 9,11,12,13,17,19,20 and 22 are not yet available. The integrated terrain unit for Atlantic County including land use/land cover, soils, USGS floodprone areas, and geology should be completed by April. In addition, the Upper Wetlands Boundary for quad 157 is not available yet. The other data layers are either not funded or have no set time for their completion. Please get back in touch with this Office in several months concerning these data layers.

We are interesting in receiving notification of when the project is completed and a list of the digital data layers produced as part of the project. Should you have any questions concerning these issues or the data, please give me a call (609) 633-8144.

Sincerely,
Lawrence L. Thornton

Lawrence L. Thornton
Research Scientist

enclosures
c:Bernard J. Moore, NJDEPE
Doug Gaffney, COE

HANKIN, SANDSON & SANDMAN
COUNSELLORS AT LAW
A PROFESSIONAL CORPORATION
30 SOUTH NEW YORK AVENUE
ATLANTIC CITY, NJ 08401

STEPHEN HANKIN
Member of New Jersey
and District of Columbia Bars

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and Georgia Bars

ROBERT S. SANDMAN
Certified Civil Trial Attorney
Member of the New Jersey
and Pennsylvania Bars

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Member of the New Jersey
and Pennsylvania Bars

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Member of the New Jersey Bar

TELEPHONE NUMBER
(609) 344-5161

TELECOPY NUMBER
(609) 344-7913

September 6, 1993

SEP 07 1994

Our File Number

Lt. Colonel Kenneth H. Clow
Department of the Army
Philadelphia District
Corps of Engineers
Custom House 2nd and Chestnut Streets
Philadelphia, PA 19106-2991

RE: Longport Shoreline - Great Egg Harbor Bay Inlet - Dredging Project

Dear Lieutenant Colonel Clow:

I last wrote you almost a year ago respecting the above-captioned matter and the then completed dredging project.

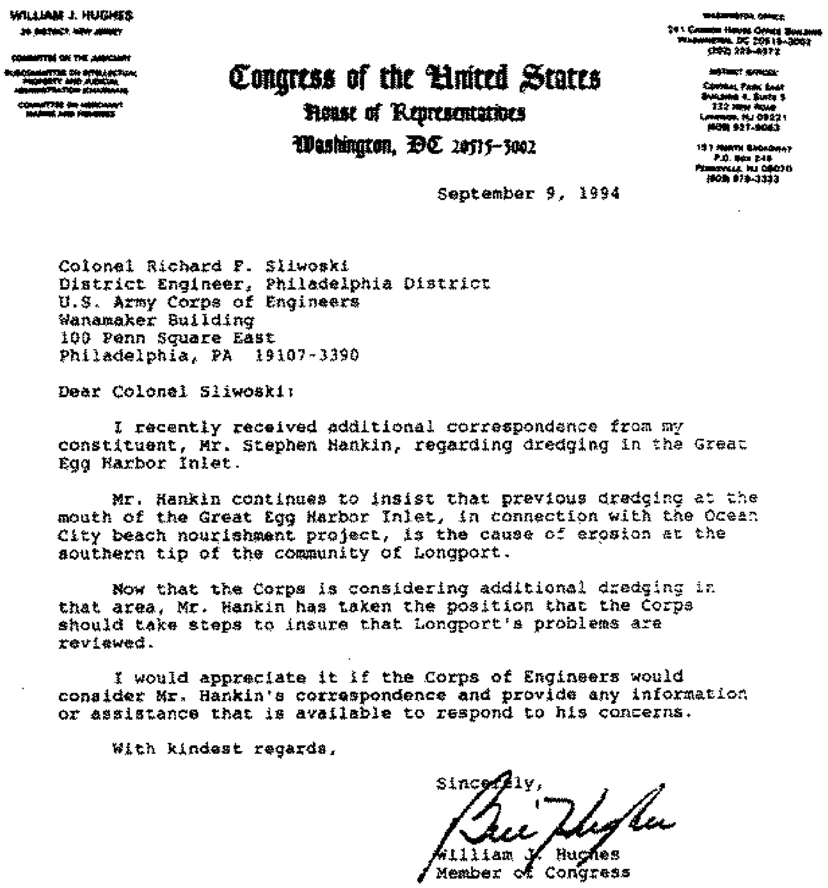
We have recently received word that the Corp will soon begin dredging again which we find highly objectionable, given what is a universal conclusion regarding the complete loss of beach at the southern end of Longport due to the dredging that was completed last year. While we were fortunate enough to receive a small rock revetment, the condition at the Southern tip of Longport is nonetheless disastrous. We would indeed be less than remiss if we did not object to the project going forward absent some modification to permit some sand to be diverted to Longport. We are undergoing a treacherous situation here even on mild days. Human life and property are in serious jeopardy and we cannot allow this project to make matters worse.

Please let me hear from you at your very earliest convenience.

Thank you.

Very truly yours,

STEPHEN HANKIN
SH/js
Enclosure
cc: See Attached Service List



WILLIAM J. HUGHES

Congress of the United States
House of Representatives
Washington, DC 20515-3002

September 9, 1994

Colonel Richard F. Sliwoski
District Engineer, Philadelphia District
U.S. Army Corps of Engineers
Wanamaker Building
100 Penn Square East
Philadelphia, PA 19107-3390

Dear Colonel Sliwoski:

I recently received additional correspondence from my constituent, Mr. Stephen Hankin, regarding dredging in the Great Egg Harbor Inlet.

Mr. Hankin continues to insist that previous dredging at the mouth of the Great Egg Harbor Inlet, in connection with the Ocean City beach nourishment project, is the cause of erosion at the southern tip of the community of Longport.

Now that the Corps is considering additional dredging in that area, Mr. Hankin has taken the position that the Corps should take steps to insure that Longport's problems are reviewed.

I would appreciate it if the Corps of Engineers would consider Mr. Hankin's correspondence and provide any information or assistance that is available to respond to his concerns.

With kindest regards,

Sincerely,

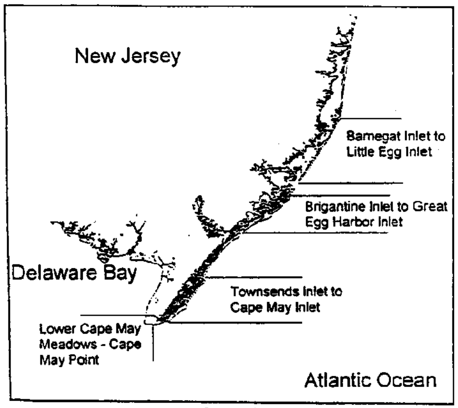
Bill Hughes

William J. Hughes
Member of Congress

US Army Corps of Engineers
Philadelphia District

NEW JERSEY
SHORE PROTECTION STUDY
UPDATE

JUNE 1994 INFORMATION BULLETIN NUMBER 5



Areas of ongoing studies.

STUDY UPDATE

The New Jersey Shore Protection Study was initiated in 1989 in response to water quality concerns, beach erosion and storm damage along the coast. The Limited Reconnaissance Study included the entire New Jersey coast from Sandy Hook to Cape May. The study was completed in September 1990, and recommended six specific areas of the New Jersey coast for further study. Four of the six areas are currently under study.

The Townsends Inlet to Cape May Inlet Reconnaissance Study was completed in January 1992, and the Brigantine Inlet to Great Egg Harbor Inlet Reconnaissance Study was completed in February 1992. Both studies have progressed into the Feasibility Phase of the Corps' Civil Works planning study process, cost-shared with the New Jersey Department of Environmental Protection and Energy (NJDEPE) as the non-federal sponsor. Reconnaissance studies were initiated for Lower Cape May Meadows in March 1993, and for Barnegat Inlet to Little Egg Inlet (Long Beach Island) in March 1994. Cape May Point was added to the Cape May Meadows study in October 1993.

Townsends Inlet to Cape May Inlet

The Townsends Inlet to Cape May Inlet Feasibility Study began in December 1992. Shore protection measures will be examined along the ocean fronts of Avalon and Stone Harbor, as well as the inlet frontages of Avalon and North Wildwood. The southern end of Stone Harbor near Hereford Inlet is an undeveloped wildlife conservation area which serves as an important stopover location for migratory shorebirds and birds of prey, as well as a buffer against storm waves. This area is rapidly eroding, especially behind the terminal groin and revetment. The Feasibility Study is investigating the possible causes for the erosion of this valuable habitat, the impact on the surrounding community, and potential solutions.

Brigantine Inlet to Great Egg Harbor Inlet

The Brigantine Inlet to Great Egg Harbor Inlet Feasibility Study began in March 1993. Shore protection measures will be examined for the Brigantine oceanfront, the Absecon Inlet frontage of Atlantic City, and the oceanfront of Absecon Island. The study is being conducted in two stages. The first stage is the Absecon Island Interim Study, which is currently underway. This stage includes ongoing data collection efforts to analyze coastal processes along the entire study area.

The second stage is the Brigantine Island Interim Study which will result in the final feasibility report.

Both Feasibility Studies are being cost shared 50%-50% between the Federal government and the NJDEPE. All interested parties are encouraged to be actively involved during the Feasibility Phase because it is during this phase that a specific shore protection plan begins to take shape.

Lower Cape May Meadows-Cape May Point

The Lower Cape May Meadows Reconnaissance Study began in March 1993. Lower Cape May Meadows comprises 350 acres of undeveloped oceanfront land which includes Cape May State Park and the Cape May Migratory Bird Refuge owned by the Nature Conservancy. Both of these areas contain unique freshwater wetlands. The Meadows is home for threatened and endangered birds such as the piping plover. Vast numbers of migratory birds such as American bald eagles, peregrine falcons, osprey and other raptors use the area to rest and feed as they travel along the North Atlantic Flyway. However, this vital habitat, which is one of the most visited avian viewing areas on the East Coast, is threatened by erosion.

The natural transport of sand along the coast of New Jersey has been altered over the years by development. One aspect of this development is the use of inlets for commercial and recreational navigation.

Birdwatchers at Cape May Point State Park.

At Cape May Inlet in 1911, jetties were built to stabilize the navigation channel. The purpose of the Cape May Inlet jetties is to prevent sand from entering the inlet, but they also hinder sand from reaching Lower Cape May Meadows. This makes the effects of gradual erosion processes more pronounced, and increases the area's susceptibility to storm damage. In addition, saltwater from the ocean enters the freshwater wetlands during storms, severely altering the habitat. The Reconnaissance Study will investigate environmental protection measures and the effects the Cape May Inlet jetties may have had on Lower Cape May Meadows.

In response to the concerns of Congress, the Lower Cape May Meadows Reconnaissance Study was expanded in October 1993 to include the Borough of Cape May Point. Cape May Point is a residential community with approximately one mile of shorefront. Here, the Delaware Bay meets the Atlantic Ocean, producing complex wave and current interactions. Continuous erosion at Cape May Point has prompted the repeated construction of various shore protection projects over the years. The most recent projects included the nine existing groins built in the 1960's, and small scale beachfills placed after the recent storms. Even with these projects, Cape May Point is still subject to beach erosion and storm damage. The Reconnaissance Study will investigate hurricane and storm damage reduction measures for this area.

Barnegat Inlet to Little Egg Inlet (Long Beach Island)

The Barnegat Inlet to Little Egg Inlet Reconnaissance Study began in March 1994. The study area extends approximately 20 miles along Long Beach Island and includes the communities of: Barnegat Light, Harvey Cedars, Surf City, Ship Bottom, Beach Haven and Long Beach Township. Like many barrier islands, erosion over the years has narrowed most of the beaches of Long Beach Island, reducing the storm protection to communities provided by the beach and dunes.

Protection of the barrier island will also help protect environmentally sensitive areas inland. To the west of Long Beach Island are Barnegat Bay and Little Egg Harbor, which are two of the largest bays along the New Jersey Coast. Both are abundant sources of fish and shellfish, providing recreation and commerce for the area as well as habitat for a variety of species of fish and wildlife, both migratory and native. The presence of a stable barrier island will prevent breaches, such as those which occurred at Harvey Cedars during the December 1992 storm. Such events can alter water salinity in the back bay. Investigating water quality and coastal pollution problems are objectives of the overall New Jersey Shore Protection Study.

DATA COLLECTION

A thorough understanding of coastal processes is needed to improve the implementation of shore protection projects. Coastal processes include such topics as sand transport, breaking wave dynamics, and wave/current interaction in the vicinity of coastal inlets. Data collection efforts are underway to gain a better understanding of the coastal processes of Townsends, Hereford and Absecon Inlets, and their impacts on adjacent shorelines.

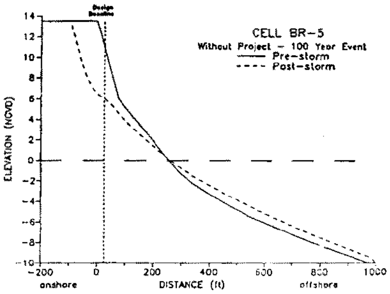
Beach and Hydrographic Surveys

Most beaches experience a seasonal cycle of erosion and accretion. Storms in the winter remove sand and deposit it temporarily in offshore bars in shallow water. During the summer months, waves return sand from the bars to the beach. However, major storms, such as the Northeaster of December 1992, can cause a permanent loss of sand. Strong storm waves can take sand from the beach and deposit it at depths of over 20 feet. Lower velocity waves on a calm day are not strong enough to suspend the sand and return it to the beach. As a result, storms such as northeasters can remove large quantities of sand from the natural ocean transport system.

December 1992 Storm - Brant Beach.

Beach and hydrographic data are used to study beach changes. Surveyors use standard techniques to survey the beach at specific locations. Hydrographic surveys take place in the nearshore zone, the area of shallow water extending from the shoreline to where the waves break. Usually, a boat uses an acoustic sounder to measure water depth. The data collected from beach and hydrographic surveys is used to produce a profile image of the beach from the dune line through the nearshore zone.

Beach surveys along Absecon Island, Seven Mile Beach, Five Mile Beach and Lower Cape May Meadows were completed during the summer and winter of 1993. Brigantine Island beach surveys were completed this spring. Hydrographic surveys have been completed for Lower Cape May Meadows in September and Absecon Island in December. Hydrographic surveys of Townsends, Hereford, and Absecon Inlets were conducted during the winter. Results of these surveys will be used to map the location and depth of the channels.



Example of beach profile.

In addition to the survey data, samples of beach material were taken along selected profile lines when the surveys were performed. These samples are analyzed to characterize the beach by grain size and composition. This information will help the Corps to find compatible beach material for specific locations, if beachfill material is required.

Sampling of offshore sand deposits was completed in October. These samples are being analyzed for grain size and composition. This information will be compared to the results of the beach sample analyses and acoustic sub-bottom profiling to determine the most suitable source(s) of beachfill material. Once identified, these borrow areas may be valuable resources to various agencies after a major storm.

Avalon '93 Project

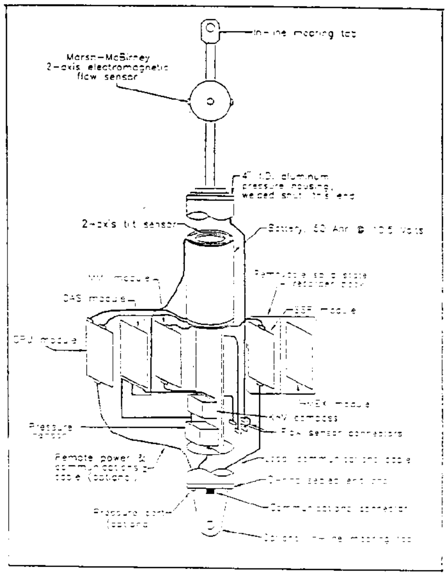
During the summer of 1993, the Borough of Avalon implemented a shore protection project of its own to test some experimental methods of sand retention. The project included the placement of sand-filled textile tubing along the inlet frontage and a 150,000 cubic yard beachfill along the oceanfront between the 8th Street jetty and 17th Street. In addition, an artificial reef about 1,000 feet long was placed offshore between the 8th Street jetty and 11th Street prior to the beachfill. The reef is composed of interlocking hollow concrete sections. The purpose of the reef is to dissipate some of the incoming wave energy and prevent outgoing currents from carrying sand to deeper water.

The Stevens Institute of Technology (SIT) tested the reef design before it was installed. SIT will be monitoring the performance of the reef over the next two years by obtaining field data every three months and after major storms. Stockton State College will be obtaining beach profiles of the area. In addition, data collected by the ongoing Townsends Inlet to Cape May Inlet Study will also be used to help monitor the project.

Wave, Tide and Current Data

Wave gauges were installed near Avalon in June and near Atlantic City in October of 1993. They were deployed by boat in depths varying from 10 to 42 feet. The gauges are the PUV type which record changes in pressure and direction of flow along two axis. Water pressure relates to wave height. The data is collected in twenty minute durations every three hours. The data will be retrieved by a diver every two months. After analysis, this data will provide a directional wave spectrum along with tidal elevation and ambient current speed and direction. The current spectrum will be decomposed to provide tidal and wave driven currents.

Tide gauges have been installed in the back bay channels. Supplemental current data is being collected in the inlets using acoustic doppler current profiler technology.



PUV (Pressure, U-V Direction) wave gauge.

This information and the survey data will be used as input for numerical models which will simulate various coastal processes such as wave transformation, storm damage, ebb and flood flow during tides and shoreline changes.

All of the data collection and cooperative efforts discussed above, will provide valuable quantitative coastal information. This data will be helpful for our existing study areas as well as other locations along the New Jersey coast which experience severe erosion and storm damage.

Mapping & Photogrammetry

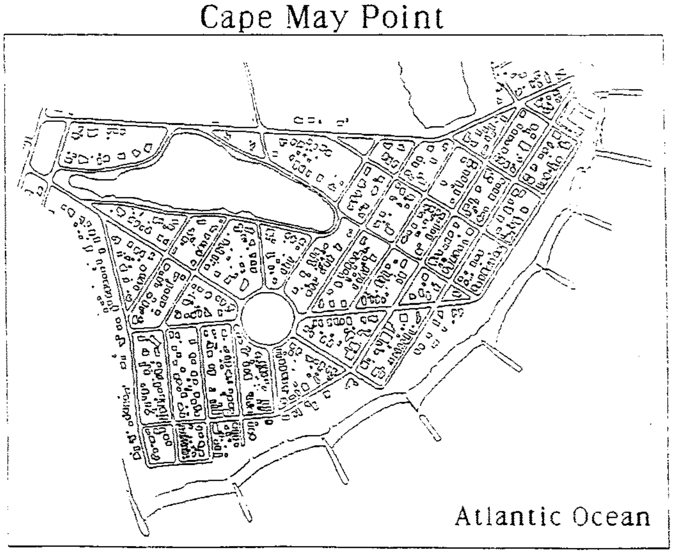
Aerial photographs of the study areas taken in March and October of 1993 are being combined with the beach and hydrographic survey data to develop digital orthophotographs. Orthophotographs form the basis of the Geographic Information System (GIS) because they are referenced to a mapping datum. All data collected during these studies is also referenced to the same datum which is the New Jersey State Plane Coordinate System, North American Datum 1983.

The GIS can accurately depict beachfront structures, many public works features, and elevations. The GIS will also include geotechnical and other types of data obtained during the course of the New Jersey Shore Protection Study.

In addition, the Philadelphia District has entered into a Data Sharing Agreement with the NJDEPE. The NJDEPE is providing maps in digital format for Cape May and Atlantic Counties for use in the studies. These maps represent: areas of dredging and dredge material disposal, tidal wetlands, bird and shellfish habitats, and hydrology. In return, the District will be able to update NJDEPE shoreline change maps, and provide Digital Terrain Models (DTM's) of shore communities. The use of this information within the GIS will allow the Corps to more effectively monitor shoreline changes, storm damage, and to identify areas in New Jersey which are vulnerable to flooding during storms.

COMMENTS

We appreciate your involvement and suggestions in these ongoing studies. Your concerns and ideas are helpful to us, and will become even more important as we move into the planning and development of specific coastal projects. Please address your comments to the Philadelphia District at our address on the attached Comment Form.



An example of the Corps' New Jersey GIS.

COMMENT FORM

If you have any comments on the New Jersey Shore Protection Study, or corrections, additions, or deletions for our mailing list, please cut along the dotted line and mail the completed form to:

U.S. Army Engineer District, Philadelphia
ATTN:CENAP-PL-PC
Wanamaker Building
100 Penn Square East
Philadelphia, PA 19107-3390

______ Yes. Please correct or add my address to the New Jersey Shore Protection Study mailing list.

______ No. Please delete my name from the mailing list.

NAME: ____

ADDRESS: ______________________________________
____
____

COMMENTS:

____
____
____
____
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U. S. Army Engineer District
Philadelphia
Attn: CENAP-PL-PC
Wanamaker Building
100 Penn Square East
Philadelphia, PA 19107-3390

September 1995

US Army Corps of Engineers
Philadelphia District

New Jersey Shore Protection Study UPDATE

Editor's Note: Starting with this issue of the Update, you can expect to hear from us semiannually. Our purpose is to keep you informed on the status of each study area, while also reporting on topics of general interest to our partners in shore protection.

About this study

The U.S. Army Corps of Engineers initiated the New Jersey Shore Protection Study in 1989 to address beach erosion, water quality, and storm damage along the coast.

The initial Limited Reconnaissance Study, completed in September 1990, recommended six areas between Manasquan Inlet and Cape May for further study.

All six studies are now underway, with the New Jersey Department of Environmental Protection (NJDEP) as local sponsor. Three are in the Feasibility phase, two in the Reconnaissance phase, and one on hold (see **"The Future of Shore Protection," page 4**).

About Corps projects

Unlike grant agencies, Corps of Engineers funding is 100 percent project-based. Every project follows a three-phase process, with each phase justified and funded on its own merits.

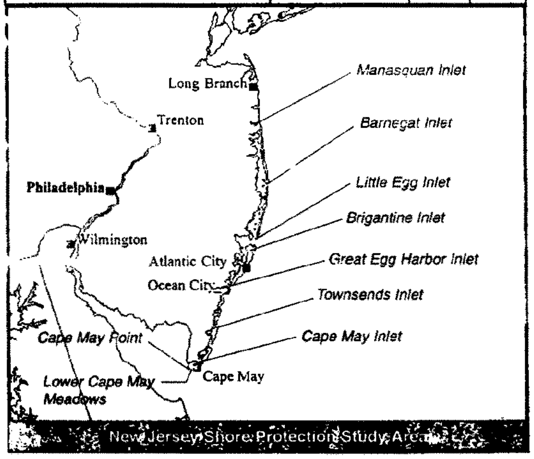
Reconnaissance

The reconnaissance phase is initiated in response to a local water resource problem. Funding for this preliminary phase is 100 percent Federal.

Corps planners carry out these activities over 12 months:

- Identify coastal erosion and water quality problems attributed to both natural and manmade causes
- Collect data on homes and other buildings, public infrastructure, and existing protective structures for storm modeling
- Use benefit-cost analysis to decide whether the Federal government should develop more detailed plans to address these problems
- Lay out the Feasibility Study and identify local sponsor(s) for non-Federal share of the cost

Project Name	Current Phase,	Start	Finish
Manasquan Inlet to Barnegat Inlet	Reconnaissance	Mar-95	Mar-96
Barnegat Inlet to Little Egg Inlet	Hold (recon complete)	Mar-94	Mar-95
Brigantine Inlet to Great Egg Harbor Inlet • Absecon Island Interim Study • Brigantine Island Interim Study	Feasibility	 Mar-93 Sep-95	 Dec-96 Nov-98
Great Egg Harbor Inlet to Townsends Inlet	Reconnaissance	Apr-95	Apr-96
Townsends Inlet to Cape May Inlet	Feasibility	Dec-92	Jul-96
Lower Cape May Meadows – Cape May Point	Feasibility	Apr-95	Aug-98



Feasibility

The Feasibility Study is where a specific shore protection plan takes shape. A non-Federal sponsor shares 50 percent of the costs. This detailed investigation usually lasts 3 to 5 years.

Working closely with other Federal, state and local authorities, the District spends much of this time complying with laws and policies and making sure no regulatory matters are overlooked. As a result of this phase, a report is processed to Congress for authorization of a project. These are some of the major tasks:

- Collect data on waves, tides, currents, movement of sand, and sand composition
- Construct predictive hydrodynamic models and refine storm models
- Determine water and sand circulation in the vicinity of the inlets
- Prepare shore protection designs which maximize national economic benefits
- Prepare Environmental Impact Statement (EIS) or Environmental Assessment (EA)

Design and construction

Under mostly Federal funding (traditionally 65/35), the District completes detailed preconstruction engineering and design, including construction plans and specifications. Private firms are then contracted to build a shore protection project based on the final Feasibility Study report.

Individual studies

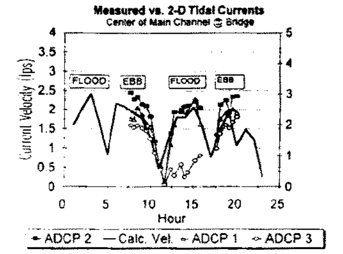
Manasquan Inlet to Barnegat Inlet

The Reconnaissance Study is focusing its modelling efforts on the "target" communities of Mantoloking, Lavallette, and Seaside Heights. Each of these maintains natural and manmade characteristics similar to those found elsewhere within the study area, and will be treated accordingly.

Philadelphia District will be looking at many issues in the course of its investigations. Here are two:

1. Public access. Localities with private beaches, insufficient parking, and/or limited beach access must ensure public access to be eligible for Federal funds.
2. Sand sources. Ocean floor contours drop sharply along this part of New Jersey, making it harder to find enough sand for replenishment.

Example of verifying current measurements with models



This study also includes Island Beach State Park, one of the last relatively undisturbed barrier islands within New Jersey. Its sand dunes, marshes, and associated wildlife are a "living laboratory" for marine biologists and other researchers. Keeping the integrity of this park will be one of the District's top priorities.

Barnegat Inlet to Little Egg Inlet

The Reconnaissance Study, which covers Long Beach Island, was just completed in March 1995. If funded, the Feasibility Study will explore erosion and storm damage solutions throughout this area. Loveladies, Harvey Cedars, Brant Beach, and Beach Haven were identified among the more vulnerable communities.

The study also identified a potential breach in the Holgate unit of Edwin B. Forsythe National Wildlife Refuge. As it might not regenerate as readily, this would cause major ecosystem degradation. The Feasibility Study will look into effective protection and/or restoration measures.

Brigantine Inlet to Great Egg Harbor Inlet

The Reconnaissance Study identified specific vulnerable sites such as the inlet frontage of Atlantic City and the oceanfronts of Brigantine, Atlantic City, Ventnor, Margate, and Longport.

The District is conducting the Feasibility Study in two stages, split geographically at Absecon Inlet. The Absecon Island draft feasibility report is due out this December, shortly after the Brigantine Island Interim Study begins (September 1995).

This report will include the results of plan formulation studies that compared the costs and benefits of many different shore protection alternatives. The one plan that maximizes net economic benefits without degrading the environment will be chosen as the National Economic Development (NED) plan. Publication of the draft report will then initiate a lengthy review process that includes public comment.

Great Egg Harbor Inlet to Townsends Inlet

The primary problems along this 16-mile coastline stem from severe beach erosion and a resulting loss of protection. Storms of moderate intensity during the winters of 1991-1993 caused considerable damage, testifying to the potential devastation of a major event.

Areas of concern include Ocean City (south of the existing Federal project), Strathmere, and Sea Isle City. Conditions at the south end of Ocean City have changed dramatically since prior Corps studies in the late 1980's.

The biggest factor has been loss of dunes since the major storms of 1991-92. At Sea Isle, erosion at the south end threatens to eventually undermine residential structures.

Townsends Inlet to Cape May Inlet

Shore protection alternatives are being evaluated along the ocean fronts of Avalon and Stone Harbor and the inlet frontages of Avalon and North Wildwood. The draft feasibility report is due out next summer (July 1996).

The southern end of Stone Harbor, near Hereford Inlet, is an undeveloped wildlife conservation area which has been eroding rapidly. It is an important stopover location for migratory shorebirds and birds of prey, and a key nesting area for herons. Erosion is most pronounced behind the terminal groin perpendicular to the beach, and along the revetment protecting the shoreline.

The District is investigating the following:

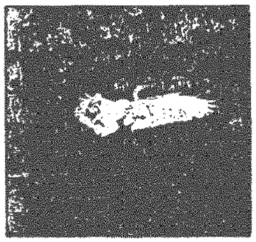
- Possible causes for the erosion of this valuable habitat
- Impact on the surrounding community
- Environmentally sensitive solutions (in coordination with NJDEP and the U.S. Fish and Wildlife Service)

Lower Cape May Meadows – Cape May Point

As Philadelphia District's first environmental restoration project, Lower Cape May Meadows represents a new concept: obtaining approval for the Feasibility phase based mainly on "environmental quality" benefits. This Feasibility Study is now moving forward with strong support from the White House.

Lower Cape May Meadows comprises 350 acres of undeveloped oceanfront land between Cape May and Cape May Point. It includes Cape May Point State Park and the Cape May Migratory Bird Refuge (owned by the Nature Conservancy), both of which contain unique freshwater wetlands.

This is one of North America's most important migratory stopovers for raptors, shorebirds, songbirds, and waterfowl. American bald eagles, peregrine falcons, and osprey are among the many species that rest and feed here along the North Atlantic Flyway.



The Meadows is also home to threatened and endangered birds such as the piping plover. Long popular among East Coast birdwatchers, it is listed as one of the nation's "Top Ten Birding Spots" in *Nature Conservancy* magazine's May/June 1995 issue. Erosion and overtopping during storms continue to seriously threaten this vital habitat.

During the Reconnaissance phase, District planners had focused on "holding the line" against further erosion. They are now exploring more ambitious options:

- Extending shoreline seaward through beach replenishment
- Restoring interior wetlands
- Managing water levels in selected areas

The close partnership that has developed between the District, the State Park, and the Nature Conservancy has clearly paid off in more thorough and innovative planning.

Along with the natural area, Philadelphia District will be looking into ways to reduce the flooding and storm damage problems at Cape May Point. Due to its proximity to Lower Cape May Meadows, just to the east, storm events that overtop or breach the Meadows dunes invariably cause flooding in the town's low lying areas. The good news is that any effective solution for the Meadows will also help Cape May Point.

For those who may be wondering, the existing Cape May beachfill project offers few side benefits for Cape May Point. Local shoreline geometry and offshore depths merely divert sand to the ocean, preventing appreciable "natural" nourishment of downdrift beaches.

Local cooperation needed on real estate

As shore protection plans unfold during the Feasibility phase, local sponsors can and should start addressing financing and real estate issues. These mostly administrative items often become "loose ends" that delay the onset of project construction.

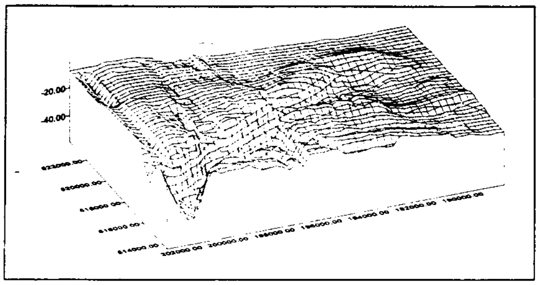
Bear in mind that real estate acquisition (and all associated costs) is the full responsibility of the non-Federal sponsor, which in this case is the State of New Jersey. It is then up to the state to work out further arrangements with local municipalities. Here is a brief overview of the acquisition process:

1. *Project Cooperation Agreement (PCA).* This legally binding document identifies the non-Federal Sponsor and explains the obligation of both parties for project construction. Under terms of the PCA, the Sponsor is responsible for acquiring all lands, easements, and rights-of-way required for the project. Public access to the beachfront area, with adequate parking, is a requirement for shore protection projects.
2. *State Aid Agreement.* The Sponsor signs an agreement with local municipalities which, in most cases, requires the municipality to acquire the necessary real estate.
3. *Final Right-of-Way Drawings.* The Corps of Engineers will forward to the Sponsor final right-of-way drawings showing real estate to be acquired. A permanent easement is usually required for shore protection.
4. The Sponsor (or municipality) must then do the following:

- *Appraisals.* Arrange for appraisal of each property (if any) to be acquired. The Corps will review the appraiser's qualifications and all actual appraisals.
- *Surveys.* Arrange for any required surveys of property to be acquired.
- *Title Evidence.* Order title evidence for each property to be acquired.
- *Acquisition.* Acquire the property. Always offer fair market value to property owners. Most acquisitions can be concluded through direct purchase.

5. *Certification.* Once all property has been acquired, the Sponsor will send evidence of public ownership to the Corps for review and certification.

Municipalities that start real estate planning at the Feasibility stage greatly improve the chances of a smooth transition to design and construction.



3-D bathymetric profile of underwater elevations

Where GIS fits in

While real estate acquisition is a non-Federal responsibility, the Philadelphia District can offer invaluable technical assistance. One way they can help is with precise mapping and identification of property.

The powerful planning tool known as GIS (Geographic Information System) combines computerized mapping and database technologies. It is excellent for keeping track of real estate ownership and land boundaries (known as "cadastral mapping").

Philadelphia District, along with the State of New Jersey and some municipalities, uses GIS extensively for its shore protection projects. Within the site-specific GIS, District planners can run queries, analyze data, and use real estate information to help design the project.

Inputs processed by GIS include the following:

- Aerial photos (georeferenced to the earth to create a scale map)
- Topographic (land) and bathymetric (underwater) elevation measurements
- Infrastructure statistics
- Tax data (lots, easements)
- Land classification (beaches, mud flats, wetlands, developed areas)

All this is fed into the GIS database and linked to map locations. As a result, any one feature represents not just a place name or set of coordinates, but a wealth of related information. GIS is faster, more accurate, and far more versatile than conventional methods.

The Philadelphia District routinely shares GIS data with state and local partners, and also helps the supporting Real Estate office in Baltimore maintain its cadastral (property) maps. While this information can be made available upon request by local municipalities, it is only as accurate as the data they originally supplied.

The future of shore protection

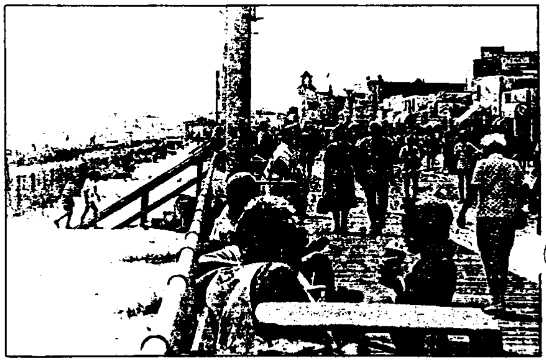
The Clinton Administration has proposed that the Corps of Engineers no longer be involved in shore protection. But for now this involves only executive policy, not Federal law. It affects portions of the New Jersey Shore Protection Study immediately, but no decisions are final.

Under current administration policy, the Corps will complete any project phase (reconnaissance, feasib ity, design or construction) already underway, but proceed no further. In other words, they will finish what they started. For instance, Ocean City beachfill work is already well underway and is thus far unaffected.

The first impact of this policy change was at Long Beach Island, where Philadelphia District completed its Reconnaissance Study in March 1995. Despite positive study recommendations, the Feasibility phase is on hold for now. The only study area exempt from the new policy is Lower Cape May Meadows – Cape May Point, as environmental restoration is still considered within the redefined national interest.

This issue will ultimately be settled in Washington, D.C. The debate is mainly economic: Is restoration of beaches and other coastal areas a good investment for the nation? Here are some key statistics:

- New Jersey beaches support a $7 billion tourism industry and appr mately 350,000 jobs
- 25 percent of the U.S. population lives within 300 miles (an easy weekend trip) of these beaches
- Existing shore protection projects prevented about $20 million in damages at Ocean City and $9 million at Cape May during the most recent major storm (December 1992)



CENAP-PL-E

DEC 0 4 1995

SWANDA
mls/6556
30 Nov 95

PASQUALE

BURNES

CALLEGARI

Environmental Resources Branch

Ms. Dorothy P. Guzzo, Administrator
New Jersey Historic Preservation Office
New Jersey Department of Environmental Protection
CN 404
Trenton, New Jersey 08625

Dear Ms. Guzzo:

The U.S. Army Corps of Engineers, Philadelphia District, has recently completed cultural resources investigations on Absecon Island, Atlantic County, New Jersey as part of the Brigantine Inlet to Great Egg Harbor Inlet Feasibility Study. The first investigation, entitled A Phase 1 Submerged and Shoreline Cultural Resources Investigation, Absecon Island, Atlantic County, New Jersey (Cox and Hunter, March 1995), involved underwater remote sensing survey of two potential sand borrow areas and a tidal zone shoreline survey.

Remote sensing survey identified seven high probability targets within Borrow Area 1. Two potentially significant historic resources, the Steeplechase Pier and the Garden Pier, are located within the shoreline project area. No archaeological cultural resources were observed along the shoreline. No anomalies exhibiting shipwreck characteristics were identified in Borrow Area 2.

Subsequent investigations conducted in October, 1995 involved additional remote sensing within Borrow Area 1, remote sensing within the Longport Borrow Area, and underwater ground truthing of newly documented and previously recorded high probability targets. The results of this investigation is enclosed as an executive summary entitled Phase 1 and 2 Submerged and Shoreline Cultural Resources Investigation, Brigantine to Hereford Inlet, Atlantic and Cape May Counties, New Jersey, Army Corps of Engineers, Philadelphia District (Cox, 1995). Ground truthing operations and re-analysis of survey data suggests that five targets in Borrow Area 1 are potential shipwreck sites. No remote sensing targets were identified in the Longport Borrow Area.

As a result of our review of the above reports, the Corps has found that the proposed dredging activities in Borrow Area 1 could cause physical destruction or damage to five potentially significant magnetic anomalies. However, it is our position that the impacts can be avoided and that measures can be taken to ensure that the project will have no effect on the submerged resources. Each target will be avoided during proposed dredging operations by delineating a 200 foot buffer around each location. The District anticipates that sand placement will have no effect on the two pier structures.

Please review the enclosed documentation and provide this office with your opinion regarding our "No Effect" finding within 30 days of the date of this letter. Should you have any questions regarding this matter, please contact Michael Swanda, Environmental Resources Branch, at (215) 656-6556 or by writing to the above address.

Sincerely,

Robert L. Callegari
Chief, Planning Division

Enclosure

Copies Furnished:
CENAP-PL-PC, Gaffney

State of New Jersey

Christine Todd Whitman
Governor

Department of Environmental Protection
Division of Parks and Forestry
Historic Preservation Office
CN-404
Trenton, N.J. 08625-0404
TEL. (609) 292-2023
FAX: (609) 984-0578

Robert C. Shinn, Jr.
Commissioner

HPO-A96-167
January 19, 1996

Mr. Robert L. Callegari
Chief, Planning Division
Philadelphia District, Corps of Engineers
Wanamaker Building
100 Penn Square East
Philadelphia, Pennsylvania 19107-3390

Attn: Michael Swanda

Dear Mr. Callegari:

As Deputy State Historic Preservation Officer for New Jersey, in accordance with 36 CFR 800: Protection of Historic Properties, as published in the Federal Register September 2, 1986 (51 FR 31115-31125), I am providing Consultation Comments under Section 106 of the National Historic Preservation Act for the following project:

Atlantic County, Multiple Municipalities
Absecon Island: beach nourishment and two sand
borrow areas near north end of Absecon Island
United States Army Corps of Engineers

800.4 Identifying Historic Properties

To the best of my knowledge, no historic properties have been identified within the project impact zone. Consequently, pursuant to 800.4(d), this concludes the Section 106 process for the project, unless resources are discovered during implementation of the undertaking pursuant to 800.11.

ADDITIONAL COMMENTS

This finding is based in part on cultural resource surveys for the project conducted by Hunter Research, Inc. and Dolan Research, Inc. in 1995. As a result of this work, several shipwrecks and other potentially significant locations were identified. During the dredging operations, the Corps will avoid each target location identified by delineating a 200 foot buffer around each location.

The Office looks forward to receiving the final report for the project.

Thank you for providing this opportunity for review and consultation under Section 106 of the National Historic Preservation Act and for your stewardship of New Jersey's historic and prehistoric cultural resources. If you have any questions, please do not hesitate to contact Deborah Fimbel, staff reviewer for this project.

Sincerely,

Dorothy P. Guzzo
Deputy State Historic
Preservation Officer

Spring 1996

US Army Corps of Engineers.
Philadelphia District

New Jersey Shore Protection Study
UPDATE

Editor's note: the Corps of Engineers became active in fish and wildlife conservation with the Fish and Wildlife Coordination Act of 1958. Since then the Corps has taken on an increasingly prominent environmental role, with the scope of that role broadening as well. One very significant change occurred in 1990, when Congress added fish and wildlife restoration as a Corps mission — a "priority project output." That policy, which is still in effect, states that "... in investigating and planning any federal navigation, flood control, or multipurpose water resource project, full consideration shall be given to the opportunities, if any, which the project affords for fish and wildlife conservation and improvement... those structural and nonstructural measures that contribute to increasing the quantity of identified species and/or improving the quality of their habitat."

In other words, the Corps was given authority not only to maintain environmental quality, but to improve it.

The Philadelphia District has already carried out several restoration projects under this policy, with even more in the planning stages. Initiatives have included construction of artificial reefs, controlled burning of phragmites to allow revegetation with more productive species, and use of dredged materials to restore wetlands. This issue of the Update *takes a closer look at those environmental initiatives that are part of the New Jersey Shore Protection Study.*

Quantifying the value of environmental projects

How do you put a price tag on nature? You don't. But there are other ways to quantify the benefits associated with environmental restoration projects — one of which is the Habitat Evaluation Procedure (HEP).

Three of the Philadelphia District's four active feasibility studies for the New Jersey shore address the need for environmental restoration:

- Barnegat Inlet to Little Egg Inlet (erosion at the Holgate unit of Edwin B. Forsythe National Wildlife Refuge)
- Townsends Inlet to Cape May Inlet (erosion at the southern end of Stone Harbor near Hereford Inlet)
- Lower Cape May Meadows — Cape May Point (flooding in Cape May Point State Park and the Cape May Migratory Bird Refuge)

All the above involve looking for ways to stem the effects of erosion on valuable wildlife habitats.

If all projects had to be justified on *economic* benefits alone, there would be no point pursuing any of these initiatives. But HEP gives the district a way to identify *environmental* benefits, expressed not in dollars but in Habitat Units.

Here is how the Habitat Evaluation Procedure is used for a given habitat (such as a beach, forest, or marsh):

Photo courtesy of Island Beach State Park

1. District biologists, in close cooperation with the U.S. Fish and Wildlife Service, identify representative species within the habitat for which Life Requisite Factors have been identified in standard models. For each species there is one or more LRF addressing food, cover, breeding and/ or other basic needs.
2. The planners then perform field surveys to determine all the LRF values for that habitat. An LRF of 1.0 (the highest possible) indicates optimal conditions for the species, all the way to zero for total unsuitability.
3. Based on predetermined formulas, individual LRF 's are combined into a Habitat Suitability Index for each representative species.

(See HABITAT EVALUATION PROCEDURE on page 6)

Study to study

Manasquan to Barnegat

The Manasquan Inlet to Barnegat Inlet Reconnaissance Study, which addressed coastal erosion and storm damage susceptibility along Island Beach, was completed in March. The draft report is undergoing the Corps' formal review process; a certified report for public release is expected in the next couple of months.

The study confirmed the need for construction of shore protection projects within the study area. The feasibility study would fully evaluate shore protection issues within the communities of Point Pleasant Beach, Bay Head, Mantoloking, Brick Township, Lavallette, Dover Township, Seaside Heights, Seaside Park and Berkeley Township.

NJDEP has indicated a willingness to cost-share in the feasibility study and in any subsequent construction projects.

However, in accordance with current Administration policy **(see page 6)**, the corps' fiscal 1997 budget does not contain funds for the feasibility study.

Barnegat to Little Egg

After completion of the reconnaissance phase in 1995, the Barnegat Inlet to Little Egg Inlet Feasibility Study was put on hold due to the administration's policy on shore protection **(see page 6)**. Subsequent congressional action added $408,000 back into the Corps' fiscal 1996 budget, however, which allowed the study to begin in January of this year.

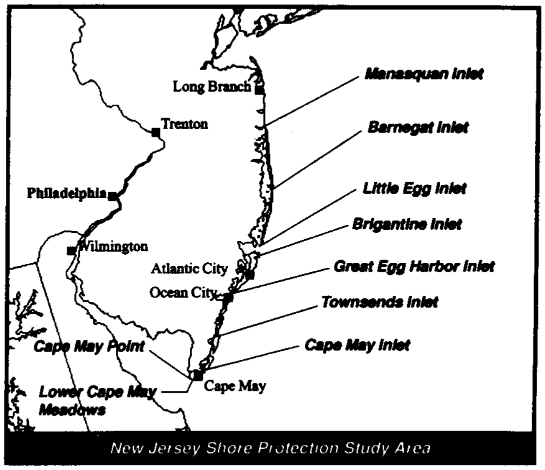
The study schedule from this point depends on annual appropriation funding. In other words, how the feasibility study will proceed beyond the current fiscal year is uncertain.

The study is exploring erosion and storm damage solutions throughout Long Beach Island. Loveladies, Harvey Cedars, Brant Beach and Beach Haven were identified among the more vulnerable communities.

The feasibility study also will be looking into effective protection and/or restoration measures to prevent a potential breach in the Holgate unit of Edwin B. Forsythe National Wildlife Refuge. This undeveloped barrier habitat is frequently flooded and overwashed by storms and even high tides. Measures to reduce flooding could make this area more suitable for a wide variety of nesting shorebirds.

In conjunction with this study, the Philadelphia District will be developing an aerial photography archive database for categorizing historic and existing shoreline changes on Long Beach Island.

Other upcoming tasks include obtaining digital orthophotography, which is used for contour mapping and ground "truthing" (verifying map data), and performing field inspections and



New Jersey Shore Protection Study Area

Project Name	Current/Last Phase	Finish	Comments
Manasquan Inlet to Barnegat Inlet	Reconnaissance	Mar-96	Next phase (feasibility) on hold, not funded
Barnegat Inlet to Little Egg Inlet	Feasibility	TBD	Current year funding restored effective January 1996
Brigantine Inlet to Great Egg Harbor Inlet • Absecon Island Interim Study • Brigantine Island Interim Study	Feasibility	 Oct-96 Nov-98	Next phase (plans and specifications) on hold, not funded
Great Egg Harbor Inlet to Townsends Inlet	Reconnaissance	Apr-96	Next phase (feasibility) on hold, not funded
Townsends Inlet to Cape May Inlet	Feasibility	Mar-97	Next phase (plans and specifications) on hold, not funded
Lower Cape May Meadows — Cape May Point	Feasibility	Aug-98	Continuing

surveys of approximately 100 beach groins along the developed shoreline.

These surveys are needed to analyze the groin structures for functionality and current effectiveness with respect to shore protection. The terminal groin at the southern end of Beach Haven is of particular interest.

Brigantine to Great Egg Harbor

The district is conducting the Brigantine Inlet to Great Egg Harbor Inlet Feasibility Study in two stages, split geographically at Absecon Inlet. The first stage, the Absecon Island interim study, is expected to be completed this October. The draft feasibility report was completed in December 1995 and was reviewed by the Corps' headquarters and NJDEP in February. The Absecon Island study reached a major milestone in May when the revised draft report with the draft Environmental Impact Statement went out for its 45-day public review period.

The report proposes a beachfill and dune for the oceanfront of Atlantic City, Ventnor, Margate and Longport, with periodic nourishment occurring every three years for the next fifty years. Additionally, two bulkheads are proposed for Atlantic City's inlet frontage in areas where storm inundation occurs.

The Brigantine Island interim study began last fall and will run through November 1998. Recent aerial photography of the area has been converted into digital orthophotography, which is used to generate accurate maps including topography and bathymetry.

Great Egg Harbor to Townsends

This study and the Manasquan Inlet to Barnegat Inlet study are at a similar stage. The reconnaissance report was completed in April and is currently under review.

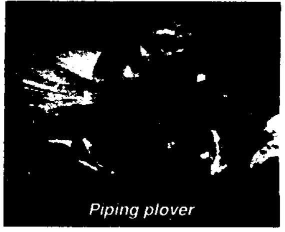
The report has identified that the primary problems along this 16-mile coastline stem from severe beach erosion and a resulting loss of protection. Storms of moderate intensity during the winters of 1991 to 1993 caused considerable damage, testifying to the potential devastation during a major event.

The biggest factor for most of the Great Egg Harbor Inlet to Townsends Inlet study area — including Strathmere, Sea Isle City and the south end of Ocean City — has been loss of dunes since the major storms of 1991, 1992 and 1996. At Sea Isle, erosion persists at the southern end.

Townsends to Cape May

Shore protection alternatives are being evaluated along the oceanfronts of Avalon and Stone Harbor and the inlet frontages of Avalon and North Wildwood. Evaluations consist of hydraulic performance during storms and the economics of damage prevention to determine the optimal project. The draft feasibility report is scheduled for completion in July. As with the Absecon Island report, it will be reviewed by the Corps' headquarters prior to release for public comment. The final feasibility report is scheduled for January 1997.

Photo courtesy of Island Beach State Park



Piping plover

In addition to the traditional shore protection issues, a significant portion of the study focuses on erosion at the undeveloped wildlife conservation area at the southern end of Stone Harbor, adjacent to Hereford Inlet. In conjunction with the U.S. Fish and Wildlife Service, NJDEP and the Borough of Stone Harbor, the district has identified coastal bayberry as the habitat of prime importance.

The district is investigating possible causes for the erosion, impacts on the surrounding community, and a range of environmentally sensitive solutions. These solutions will be incrementally analyzed using the Habitat Evaluation Procedure (see page 1).

The Meadows – Cape May Point

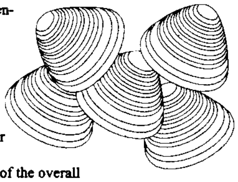
The Lower Cape May Meadows — Cape May Point Feasibility Study, which was approved mainly on the basis of "environmental quality" benefits, is now moving forward with strong support from the White House and is due for August 1998 completion.

The undeveloped 350-acre Lower Cape May Meadows, which includes Cape May Point State Park and the Cape May Migratory Bird Refuge, is one of the most important migratory bird stopovers in North America, and is also home to threatened and endangered birds such as the piping plover. Erosion and overtopping during storms continue to seriously threaten this vital habitat.

District planners are exploring several options for the Meadows, including beach replenishment, restoration of interior wetlands, water level management and phragmite control.

The feasibility study is also addressing the flooding and storm damage problems at Cape May Point, which is just east of Lower Cape May Meadows.

Results from benthic surveys show growth in surf clam numbers off the Jersey shore



When the Corps looks for suitable open-water sand borrow areas for beachfill projects, it must evaluate benthic (ocean floor) organisms in and around potential locations, with the goal of minimizing negative impacts to those organisms. The Philadelphia District contracts with private firms to conduct benthic surveys for this purpose.

These surveys also act as an indicator of the overall health of New Jersey's coastal waters. One recent survey identified 83 distinct species of benthic invertebrates, including surf clams, alive and well off the Jersey shore — particularly good news in light of ongoing concerns over the vitality of surf clams in this area!

District planners and engineers call on ACES to Organize, analyze a wide variety of coastal data

Just as the last *Update* (September 1995) highlighted the Philadelphia District's use of Geographic Information Systems, this issue looks at how another computer application — the Automated Coastal Engineering System — helps district planners and engineers with the increasingly complex task of data assimilation and analysis.

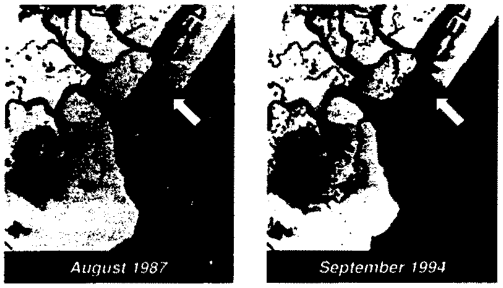
Developed by the Corps' Coastal Engineering Research Center, ACES is a collection of coastal engineering calculations, algorithms and models that is widely used in industry and academia as well as by the Corps. It includes many different types of wave calculations, coastal structural design routines and littoral process applications.

Due to the increasing complexity of coastal engineering models being developed, CERC has begun work to upgrade ACES technology from the PC to a more powerful UNIX-based workstation platform.

The latest ACES upgrade (version 2.0) represents the link between greatly expanding coastal data bases, GIS, numerically intensive coastal modelling software, and enhanced visualization of the model results. In support of this upgrade, CERC has established an ACES Pilot Committee to steer the course of future model integration efforts, including Risk and Uncertainty tools.

During one recent meeting, the committee stressed the need to get its new software into the hands of intended users as soon as possible for field testing. As part of the New Jersey Shore Protection Study, the Philadelphia District is looking to participate in this testing while improving the quality of its modelling efforts.

In conjunction with hosting the next ACES Pilot Committee this fall (date to be announced), the Philadelphia District is planning a one-day workshop that will include a hands-on demonstration of ACES 2.0.


August 1987

September 1994

Satellite images shed new light on changes to Jersey shoreline over seven-year period

Evaluating habitats in coastal study areas depends primarily on field surveys, but most of the information gained from those surveys reflects *present* conditions. But the Corps also must take into account what changes have taken place over time.

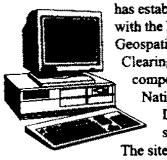
Remote sensing technology has proven to be one very useful tool for identifying long-term shoreline changes and loss of habitat. The Philadelphia District recently contracted with the University of Delaware, a forerunner in remote sensing applications for coastal habitat analysis, to do a pilot study for Stone Harbor and Hereford Inlet. Existing aerial photography was then used to georeference the remote sensing images.

Contrasting SPOT satellite images **(above)** from 1987 and 1994 show pronounced erosion at the southern end of Stone Harbor **(see white arrows)** over that seven-year period. The actual color images also revealed inlet morphology changes, such as in shoaling patterns and depths, as well as distribution of habitat types according to spectral signature — how different plants reflect light — and where habitats have changed. For instance, what was an upland sandy beach in 1987 might have become an intertidal wetland by 1994, while another location formerly underwater might now be classified as upland.

Satellite imagery classification through remote sensing has enriched the district's data collection and analysis efforts for the Townsends Inlet to Cape May Inlet study, and planners are already looking to apply this proven technology in other areas.

Access this Web site to get geospatial data

Did you know that you can obtain up-to-date geospatial data on the World Wide Web?



The U.S. Army Corps of Engineers has established a site with the National Geospatial Data Clearinghouse, a component of the National Spatial Data Infrastructure. The site web address is ***http://corps_geo1.usace.army.mil.***

Or you can start your "web surfing" at ***http://www.usace.army.mil,*** the ' home page. From this point you can access a wealth of information about not only the Corps' role in shore protection, but also its many other areas of involvement.

Your feedback matters to us

The Philadelphia District highly values your involvement. Your concerns and ideas become increasingly important as we move into the planning and development of specific coastal projects.

If you have any comments on the New Jersey Shore Protection Study, or changes for our mailing list, please cut along the dotted line and mail the completed form to this address:

U.S. Army Corps of Engineers
ATTN: CENAP-PL-PC
Wanamaker Building, 100 Penn Square East
Philadelphia, PA 19107-3390

_____ YES. Please correct my address or add it to the New Jersey Shore Protection Study mailing list.

_____ NO. Please delete my name from the mailing list.

NAME: ________________________________

ADDRESS: ________________________________

____

____

COMMENTS:

Habitat Evaluation Procedure

(from page 1)

4. Finally, the HSI's for all species are multiplied by the habitat acreage to calculate the number of Habitat Units per species.

This information enables planners to identify valuable habitats, quantifying how much of those habitats have been lost, what more would be lost if no action is taken, and what effect various initiatives might have on stemming and restoring those losses.

As environmental restoration alternatives are identified, they must be evaluated in terms of benefits and costs. So now for the next problem: How do you relate HU's to dollars? That would be a problem if the Corps was restricted to the least-cost alternative, as with projects justified on an economic basis.

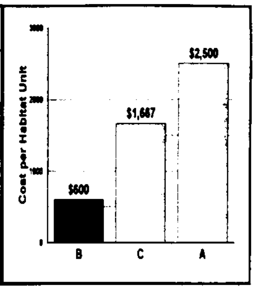
In this case, however, the focus is on *incremental* cost. Planners look for a break point at which an additional dollar spent yields a minimal increase in HU's.

Consider a purely hypothetical example of three environmental restoration alternatives **(see table above)**. Based on incremental analysis, Alternative B is the best choice. It yields far greater environmental benefits than Alternative A at only a slightly higher cost, while the additional gains from Alternative C are minimal compared with the additional investment required. Comparing the three by cost *per habitat unit* **(see graph above)**, the result is the same.

The Habitat Evaluation Procedure offers an objective, common-sense approach to decision making for environmental restoration. It is certain to play a key role in the Philadelphia District's planning process for years to come.

Alternative	Habitat Units (HU's) added	Project Cost
A	200	$500,000
B	**1000**	**$600,000**
C	1200	$2,000,000

Comparing alternatives for environmental restoration



About this study

In 1989 the U.S. Army Corps of Engineers initiated the New Jersey Shore Protection Study to address beach erosion, water quality, and storm damage along the coast.

The initial limited reconnaissance study, completed in September 1990, recommended six areas between Manasquan Inlet and Cape May for further study.

All six studies have progressed at least through the reconnaissance phase, with four now in the feasibility phase and two on hold **(see table on page 2)**. The Corps' local sponsor for project funding is the New Jersey Department of Environmental Protection.

The future of shore protection

As stated in the last Update, *the Clinton Administration has proposed that the Corps of Engineers no longer be involved in shore protection. Under current administration policy, the Corps will complete any project phase (reconnaissance, feasibility, design or construction) already underway, but proceed no further.*

The one study area affected by this policy in 1995 was Long Beach Island, where the Corps could proceed no further after completion of the reconnaissance phase. But in January, work began on the Barnegat Inlet to Little Egg Inlet Feasibility Study after Congress added it to the Corps' fiscal 1996 budget. Progression beyond fiscal 1996 will require similar action, however.

For any other study area to move forward past its current phase, it will also have to be funded by Congress on an exception basis, like Long Beach Island. And even then there is no guarantee that funding will carry over to the following fiscal year.

With the likely exception of certain environmental initiatives (such as The Meadows), the prospects for continued federal funding of shore protection projects are still very lean. Thus local involvement — and local responsibility — is becoming all the more critical.

Commander and District Engineer .... **Lt. Col. Robert P. Magnifico**
Chief, Public Affairs .... **Richard H. Chlan**
Editor .... **Ed Voigt**

The NEW JERSEY SHORE PROTECTION STUDY UPDATE is an unofficial publication authorized under AR 360-81. Circulation: 1,000. Editonal views and opinions are not necessarily those of the U.S. Army Corps of Engineers or the Department of the Army. Issues are distributed to community, government and business organizations affected by the Philadelphia District's shore protection activities in New Jersey.

Letters to the editor are welcomed and encouraged. Address mail to: Editor, NEW JERSEY SHORE PROTECTION STUDY UPDATE, U.S. Army Corps of Engineers, Wanamaker Building, 100 Penn Square East, Philadelphia, Pa., 19107.

JAMES WHELAN
MAYOR

May 17, 1996

Mr. Robert L. Calligari
U.S. Army Corps of Engineers
Environmental Resources Branch
Wanamaker Building
100 Penn Square East
Philadelphia, PA 19107-3390

RE: **Public Notice**
Absecon Island Interim Feasibility Study

Dear Mr. Calligari:

Please be advised that the City of Atlantic City formally endorses the project plan as identified by Public Notice No. CENAP-PL-F-96-02.

In accordance with meetings with the USACE, NJDEP, Atlantic City Staff and Killiam Associates, we would respectfully request you provide consideration for the following within the final project design plans:

1. Coordinate the dune height with the elevation of Atlantic City boardwalk with special consideration for the limitations of the visual impact on visitors to our community.

2. Steepen the proposed landward dune slope of 1V:5H to approximately IV:4H and situate the dune as necessary to increase the free area between the dune toe and boardwalk to allow Atlantic City to continue to maintain the boardwalk and traditional recreational activities in this area.

3. Incorporate the necessary rehabilitation of groin systems and outfalls within the project scope, as necessary, and discuss cost sharing with reimbursement by Atlantic City on these improvements.

4. Integrate our "geotube" activities and efforts within the scope of the project to assure a comprehensive approach to the treatment of same.

We would be please to have our Engineer, staff and consultants discuss the above request at further length with your office as the project design develops and in support of your project activities.

Sincerely,

James Whelan
MAYOR

State of New Jersey
Department of Environmental Protection
Christine Todd Whitman
Governor
Robert C. Shinn, Jr.
Commissioner
Natural and Historic Resources
Division of Engineering and Construction

June 28, 1996

Honorable Frank A. LoBiondo
Member of Congress
Attn: Craig
513 Cannon H.O.B.
Washington, DC 20515

Dear Congressman LoBiondo:

In response to your recent inquiry, this is to advise that the Department is in total support of the current shore protection study from Brigantine Inlet to Great Egg Harbor Inlet.

This project will provide storm protection to Brigantine and Absecon Island communities. The past coastal storms have inflicted heavy damage to the communities of Atlantic City, Ventnor, Margate and Longport. The public support for this project is overwhelming. There is a very urgent need for this project to be included in the Water Resource Development Act of 1996. The Department stands ready and willing to cost share the PEN&D phases of this work and when construction is ready, all of the necessary funds will be in place to undertake this vital project.

Due to the uncertainty of future Federal involvement in shore protection, it is of the utmost importantance that this project be included in the Water Resource Development Act of 1996. The State stands ready to sign the necessary PCA and to obtain all the necessary easements and right-of-ways that are required.

Your help and assistance in moving this project forward will be greatly appreciated.

Sincerely,

Bernard J. Moore
Administrator

mm
c Phila. Dist. Corps of Engineers